140185

Declaration for the Record of Decision (ROD)
Ionia City Landfill

A. SITE NAME AND LOCATION

Ionia City Landfill
Ionia, Michigan

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the remedial action selected by U.S. EPA for the Ionia City Landfill site in Ionia, Michigan. U.S. EPA selects this remedial action in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable with the National Contingency Plan (NCP). The decisions here are based on information in the administrative record for this site.

The State of Michigan is not expected to concur with the selected remedy.

C. ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response actions selected by U.S. EPA in this ROD, may present an imminent and substantial endangerment to human health, welfare, or the environment.

D. DESCRIPTION OF THE SELECTED REMEDY

The objectives of the response actions approved for this site are to protect public health, welfare and the environment and to comply with applicable federal and state laws. The remedy outlines specific actions to address ground-water contamination.

The major components of the selected remedy include:

- Continued operation of the existing pump and treat system
- Monitored natural attenuation/long-term monitoring, and
- Institutional controls

E. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies, to the maximum extent practicable. It does satisfy the statutory preference for treatment that

reduces toxicity, mobility, or volume through treatment as a principal element through the continued operation of the existing pump and treat system.

Because this remedy will result in hazardous substances remaining on site at levels preventing unlimited exposure and unrestricted use after the remedial action has taken place, the five-year review requirement applies to this action.

F. DATA CERTIFICATION CHECKLIST

The following information is in the *Decision Summary* section of this ROD. Additional information is in the administrative record file for this site.

- ✓ Chemicals of concern (COCs) and their respective concentrations
- ✓ Baseline risk represented by the COCs
- ✓ Cleanup levels established for COCs and the basis for the levels
- ✓ Current and future land and ground-water use assumptions used in the baseline risk assessment and ROD
- ✓ Land and ground-water use that will be available at the site as a result of the selected remedy
- ✓ Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected
- ✓ Decisive factor(s) that led to selecting the remedy (*i.e.*, describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria)

Wm. E. Muno

William E. Muno,
Superfund Division Director

9/28/00

Date

U.S. EPA SUPERFUND
RECORD OF DECISION

IONIA CITY LANDFILL

IONIA, MICHIGAN
SEPTEMBER 2000

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RECORD OF DECISION SUMMARY
IONIA CITY LANDFILL
CERCLIS ID: MID 980 794 416

A. SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The former Ionia City Landfill is located in Ionia County, Michigan. The site, which is owned by the City of Ionia, is situated on approximately 20 acres of land located within the floodplain of the Grand River. The landfill is zoned "light industrial," and is bounded by Cleveland Street to the west, the Grand River to the south, a mixed residential and light commercial area to the north, and to the east by a tributary to the Grand River known as the Kanouse Drain and a wetland. See Figure 1.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The City of Ionia owned and operated the landfill as a disposal site for municipal and industrial wastes from the mid-to-late 1950's until it was closed in 1968 or 1969. During the operating life of the landfill, both industrial wastes and municipal and commercial wastes were received by the landfill. In October 1965, an explosion occurred during the burning of wastes, resulting in the death of a waste hauler. In 1966, the Michigan Department of Natural Resources (MDNR) classified the site an open dump. Although the landfill was closed, additional wastes continued to be disposed of at the site through the 1970's.

During June, 1981, representatives from the MDNR and the city addressed the immediate site problems. During this period approximately 100 drums containing both liquid and solid material were excavated from Area A. Of the estimated 100 drums approximately 10 drums were sampled. Analyses indicated that the drum contents were representative of paint thinners and industrial solvents (trichloroethylene, methylene chloride, styrene, toluene, and xylene). The city placed snow fences around the excavated drums to prevent personal contact with the materials.

From 1981 to 1987, the U.S. EPA and MDNR performed several sampling events in an attempt to determine drum contents, possible surface water and sediment contamination, and possible groundwater contamination. In November 1981, the two closest municipal wells, located more than a mile from the site, were tested for 1,1 dichloroethane, 1,2 dichloroethylene, methyl chloroform, toluene, and trichloroethylene. None of these compounds were detected in either well sample. In addition, samples from wells serving the Michigan Reformatory and the Riverside Correctional Facility, located along the Grand River approximately one mile downstream from the landfill, were analyzed for halogenated and non-halogenated volatile hydrocarbons, and again no compounds were detected.

The site was proposed for placement on the NPL on December 30, 1982 and was finally listed on September 8, 1983.

In 1984, the City of Ionia, pursuant to the terms of an administrative order, conducted the following activities at the site: 1) secured the site by constructing a fence around Area A; 2) removed and disposed of exposed drums in Area A; and 3) placed a clay rich cap over the area where drums were removed to reduce infiltration of precipitation. In June 1985, additional exposed drums were removed, a security fence was installed and warning signs were posted.

In 1986, U.S. EPA entered into an agreement with two PRPs to conduct a Remedial Investigation / Feasibility Study (RI/FS). The RI/FS began in 1987 and was completed in 1989. At that time, EPA determined that the point source of contamination (buried drums, bulk wastes, and contaminated soil) and the contaminated groundwater required cleanup.

A record of decision was signed on September 29, 1989 which called for:

- In-situ vitrification (ISV) of the defined point source area and an adjacent margin of safety zone;
- fencing the site to restrict access;
- placement of at least 3 monitoring wells in the shallow A-1 aquifer immediately downgradient of the point source area;
- institutional controls to restrict the use of the site;
- upgrading the landfill cover and repairing the side slopes, as needed, followed by revegetation to minimize future erosion and insure integrity of the landfill cap.

In 1991, 18 PRPs signed a consent decree to implement ISV. In 1992, an engineering-scale treatability study was undertaken to further characterize the source area and verify the suitability of site soils and waste materials to the technology.

In 1992, the point source area was prepared for ISV. All intact drums containing liquids were removed and transported off-site for disposal. Some drums were damaged during the removal and their contents were spilled into the soils of the point source excavation area. Remaining waste materials, including drum fragments and soils, were distributed evenly through the point source area to facilitate in-situ vitrification (ISV) treatment at the full-scale level. Following recompaction, a clay layer and a geomembrane were placed over the excavated point source area in early 1993.

In late 1993, ISV was bench-scale tested and operational issues were encountered. These operational issues and resulting delays, ongoing evaluation of performance data and design modifications to the single full-scale operational unit extended the beginning of the project into Spring 1994, well beyond the planned completion date. Practical application of the ISV technology to contaminated sites became questionable during this period. Groundwater continued to be monitored and it was found that groundwater quality immediately downgradient of the point source area continued to deteriorate significantly, most likely as a result of the site preparation work conducted in 1992.

U.S. EPA and MDEQ expressed concern about the potential impact of groundwater contamination on the Grand River. In a letter to the PRPs dated April 18, 1994, the U.S. EPA determined that current conditions at the site, attributed to releases from the point source area in the shallow groundwater aquifer, may have presented an imminent and substantial endangerment to the environment. Moreover, U.S. EPA concluded that measures should be taken to contain the contaminant plume and insure protection of the Grand River. Therefore, on October 24, 1994, U.S. EPA entered into an Administrative Order with the PRPs to implement a soil removal action. This Order called for the excavation and off-site disposal of impacted soil and wastes.

In late 1994, pursuant to an EPA Administrative Order, the PRPs conducted a removal action for the point source where approximately 12,267 tons of waste material and contaminated soils were excavated, transported off-site, and disposed of at a RCRA-approved, CERCLA-compliant facility. Clean sand obtained from an off-site source was used to backfill the excavation and an 18-inch cap composed of clay/clay-rich material was placed over the sand backfill. In Spring 1995, site restoration was completed with the application of top soil and perennial seed mixture suitable to the climate of the region. This action removed the known point source for the site which has eliminated the need for ISV, or any other soil remedy for the site.

On June 13, 1995, the U.S. EPA approved another removal action to contain groundwater which called for the implementation of a groundwater pump and treat system for obtaining hydraulic control and treating the impacted groundwater, as defined by the 500 µg/l isocontour, for volatile organic chemicals (VOCs). This removal action was implemented to prevent the migration of hazardous substances at unacceptable levels in groundwater toward the Grand River. U.S. EPA concluded that if groundwater was allowed to remain uncontrolled, it may have constituted an imminent and substantial endangerment to human health and the environment.

In May 1999, the City of Ionia granted a wastewater discharge permit to the Ionia City Landfill PRP group for the discharge of the treated effluent from the groundwater treatment system to the City of Ionia's publicly owned treatment works (POTW). In that same month, the pump and treat system was turned on and treated groundwater was discharged to the City of Ionia through piping connected to the City's sanitary sewer along Cleveland Street.

In March 2000, recovery well number 3 was taken off line and replaced with a new recovery well (RW-3A) in a new location in the southwest portion of Area A between the fence and recreational trail. New electromagnetic flow meters were also installed on the three influent lines so that flow rates can be adequately monitored. Recovery wells 1 and 2 are presently capable of maintaining a flow rate of 3 to 8 gallons per minute (gpm) each while recovery well 3A is capable of pumping at a rate of 5 to 14 gpm.

To date, the treatment system has been operating with no exceedances of discharge parameters to the POTW. However, the system is periodically down due to iron fouling problems. The use of new materials and equipment are being explored to correct or minimize this problem.

C. COMMUNITY PARTICIPATION

All pertinent documents related to the site can be found in the information repository established at the Hall Fowler Memorial Library, Michigan Room, 126 W. Main Street, Ionia, Michigan. Administrative records have also been established at the Hall Fowler Memorial Library and the U.S. EPA Records Center, 77 W. Jackson Blvd., Chicago, Illinois.

Until 1998, MDNR was the lead agency in the implementation of community involvement activities at the site through a multi-site cooperative agreement with the U.S. EPA. EPA functioned as a support agency when requested by MDNR.

MDNR coordinated and monitored the RI/FS kick-off meeting in August of 1984, attended by approximately 30 people. In February 1986, the Region announced that it had issued an administrative order to the Mitchell Corp and the A.O. Smith Corp to investigate the potential migration of hazardous substances from the landfill and to determine remedies for the site. 1986. There was a public comment period on the order from February 20 to March 12, 1986. The FS report and the Proposed Plan on the point source cleanup alternatives were made available for public comment from August 25, 1989 to September 18, 1989. A public meeting was held on August 31, 1989 at the Ionia City Hall to answer questions and accept comments from interested parties. There were no written comments received. Two oral comments were received during the public meeting. There was limited interest in the site at this time; only three or four residents attended the public meeting. MDNR sent regular progress reports to residents and city officials.

In July of 1999, U.S. EPA conducted a series of one-on-one meetings with Ionia area residents and officials to discuss community concerns regarding the on-going investigation of the Ionia City Landfill site. The comments and concerns were documented in the final Community Involvement Plan dated December 1999.

U.S. EPA issued a Proposed Plan in June 2000, to inform the community of the proposed final groundwater remedy for the site. The community was informed of a public comment period and a public meeting via the Proposed Plan fact sheet and an advertisement in the Sentinel Standard on July 9, 2000. On July 26, 2000, U.S. EPA sponsored a public meeting at Ionia City Hall to explain the proposed remedy, answer questions and receive public comments. Citizens, along with federal, state and local government officials, were in attendance. No public comments were received during the meeting and most of the community interest revolved around potential redevelopment of the property. Concerns over when exactly information was available

in the information repository led U.S. EPA to extend the public comment period through August 30, 2000. An advertisement announcing this extension ran in the Sentinel Standard on August 11, 2000. A request for an extension to the public comment period was received just before August 11, 2000 and was granted. An advertisement announcing this extension of the public comment period through September 7, 2000 ran in the Sentinel Standard on August 25, 2000. Only a few comments were received on the U.S. EPA Proposed Plan during the total 60 day public comment period.

A summary of public comments and U.S. EPA's responses are in Appendix A.

D. SCOPE AND ROLE OF RESPONSE ACTION

The 1989 ROD only addressed the source and soil contamination component at the Ionia City Landfill. This is the final remedy for groundwater at this site. Previous source removal and control actions were completed in 1994 and were successful in removing leaking drums and contaminated soil from Area A. A pump and treat system began capturing and treating groundwater in May 1999 as an interim action and will be monitored and/or optimized to ensure containment and treatment of that portion of the plume with VOC concentrations above 500 ug/L.

U.S. EPA has already selected the remedy for the source and soil component of the site. The 1989 ROD called for the implementation of In-Situ Vitrification (ISV) of the defined point source area and an adjacent margin of safety zone along with installation of additional monitoring wells, site fencing and institutional controls. As mentioned previously, ISV was never implemented, and in 1992 the point source area was excavated and all intact drums containing liquids and impacted soil were removed and transported off-site for disposal. During preparation activities for ISV, some drums were damaged during their removal and their contents were spilled into the soils of the point source excavation area. Other waste materials were removed in 1994. Fencing and additional monitoring wells were installed and institutional controls to prohibit installation of drinking water wells were implemented. These actions addressed the point source area which was the subject of the 1989 ROD, and have eliminated the need for further soil remediation.

This ROD addresses the contamination of the groundwater aquifer. Contaminant concentrations currently in the groundwater exceed the U.S. EPA's acceptable risk range. This final response action for groundwater addresses the principal remaining threat at the site through the containment/treatment of contaminated groundwater in the aquifer.

E. SITE CHARACTERISTICS

The site consists of an older fill area (Area A of Figure 1) in the northern portion, and a later fill area (Area B of Figure 1) in the southern portion of the site. The two areas are divided by the right-of-way of the Chesapeake and Ohio Railroad, also referred to as

the Pere Marquette Railroad. The railroad tracks were removed in 1987 and this is now a recreational path for walking and bicycle riding. The site is generally flat and has a thin grassy cover, with wooded areas along the banks of the Kanouse Drain, an intermittent tributary, and the Grand River. Area A is enclosed by a chain link fence, topped with two strands of barbed wire and has an entrance gate to Cleveland Street. Warning signs are posted around Area A. Area B is not fenced.

The site is situated within the Grand River valley. The landfill is surrounded by relatively steep slopes on its northeast, east and southeast sides. There is also a steep slope on the west side of Cleveland Street which drops down approximately 10 to 15 feet to farmland. The landfill and surrounding areas are relatively flat.

Based on site investigations, two primary types of contamination releases exist: 1) runoff to the drainage ditch and to the Grand River; and 2) percolation of leachate from the landfill to the shallow aquifer beneath the site. Analytical results indicate the presence of inorganics in both the Kanouse Drain and the Grand River and organics and inorganics in the shallow aquifer beneath the site.

Sampling of the shallow aquifer, referred to as the A1 aquifer, indicated that several volatile organic chemicals and metals are present downgradient of the point source area.

No organic contaminants were detected in the ambient air samples at concentrations exceeding the OSHA permissible exposure limit or Michigan Department of Environmental Quality criteria.

During the RI, two separate trenching activities at the landfill were conducted. The first trenching event consisted of ten excavations throughout Areas A and B. The second trenching event consisted of fourteen excavations within Area A. The purpose of the investigations were to define and characterize the landfill mass. During trenching activities it was determined that the waste material remaining in Area A consists of both industrial and municipal wastes. The industrial waste consisted mainly of paint sludge, various organic materials, spent oils, and solvents. Municipal wastes were located in both Areas A and B and consisted mainly of miscellaneous municipal trash, concrete, fiberglass, construction and plant debris, and miscellaneous household garbage. The depths at which the wastes were buried in the landfill vary. Throughout Areas A and B, waste was found to be located at depths ranging from 0.5 feet to 16 feet. A bottom clay-like layer appeared to exist beneath the waste, based upon visual inspection during the trenching activities.

Site Geology

In the landfill area, the Grand River valley is approximately three-quarters of a mile wide and trends east to west. The river valley is bordered on the north and south by bluffs composed of medium textured glacial till in the form of end moraines. The end moraine

located north and south of the landfill is oriented in a general north-south direction, and is cut by the Grand River valley.

The surficial deposits in the Ionia Landfill area consist of Pleistocene epoch deposits from the most recent glaciation event, the Wisconsinian. The deposits include unconsolidated, unstratified clastic sediments from the glaciers and unconsolidated stratified gravel, sand and clay deposited by glacial streams and in glacial lakes. The deposits within the landfill include fill materials, an alluvial clay layer, a sand and gravel aquifer (A-1) and an underlying clay layer (CL-1).

During the RI, fill materials were encountered from ground surface to a depth of approximately eight feet. Fill materials include sand and gravel, cinders, glass, wood chips, bricks and similar debris. The fill materials were usually dry. Beneath the fill materials, a sandy clay layer of varying thickness (depending on location) was encountered. The layer is usually described as moist and black, containing roots, and is known as the "alluvial" layer. The presence or absence of this clay layer in various locations of the landfill is an important geologic and hydrogeologic feature.

Underlying the alluvial layer is a layer of sand and pebbles. This layer varies in thickness and is known as the A-1 aquifer. In some limited areas of the landfill, the sand and gravel of the A-1 aquifer also includes cobbles and boulders. Groundwater in the layer is typically encountered at approximately 15 feet below ground surface. Underlying the A-1 aquifer is a hard, tight, dense layer of glacial till, known as the CL-1 layer. The CL-1 layer is a confining unit that separates the A-1 aquifer and an underlying sand and gravel aquifer identified as the A-2 aquifer. The till is clayey to silty to sandy and is usually encountered 25 to 30 feet below ground surface. Underlying the A-2 aquifer is a plastic clay to clayey silt unit known as the CL-2 confining layer. The thickness and basal extent of the CL-2 layer has not been defined.

Site Hydrogeology

Groundwater in the vicinity of the Ionia City Landfill flows through permeable glacial deposits in the shallow zone (generally less than 150 feet deep) and through permeable bedrock fractures and joints at greater depths. The three local aquifers can be identified as being the glacial aquifers, the Saginaw Aquifer and the Marshall Aquifer. In addition, there is a permeable zone between the Saginaw and Marshall Aquifers where groundwater of usable quality and quantity has been encountered. This zone is in the highly fractured upper member of the Bayport Limestone and is the source for many area water wells.

The discharge zones for the glacial aquifers in the Ionia area are primarily the Grand River and other perennial streams. In addition, groundwater levels are affected by evapotranspiration in the wetland and swampy areas. The bedrock aquifers (Saginaw, Marshall, and locally existing Bayport) have no natural discharge zones in the area.

The groundwater in the glacial aquifers is recharged by precipitation and snowmelt along the Grand River floodplain and in the bordering uplands. Recharge also occurs along the Grand River as bank storage during flood periods. The bedrock aquifers are recharged in similar fashion at distant outcrop areas and other aquifer access points (rivers, lakes, fracture zones, etc.) remote from the site. Some recharge may be occurring in the bedrock aquifers from the glacial deposits. However, the probability and possible extent of such recharge is not well understood.

Habitat and Wildlife

Ecological habitat types are identified based on a qualitative field survey that was conducted by the PRPs on October 1 and 2, 1998, and information obtained from the National Wetland Inventory (NWI) of the U.S. Fish and Wildlife Service (USFWS, 1999). See Figure 2.

Three wetland areas have been identified on or adjacent to the site. The first wetland area is located within a small depression located in the northeast corner of the landfill, along the Kanouse Drain. This small depression area may be periodically inundated with water following periods of heavy rainfall (ATSDR, 1995), and is identified as a semi-permanent, intermittently flooded, open water palustrine wetland. The second wetland area is identified along the eastern border of Area A, adjacent to the Kanouse Drain. This wetland area is designated as a seasonally flooded, palustrine forested wetland, which is dominated by broad-leaved deciduous trees. The third wetland area identified is a temporarily flooded, palustrine-forested wetland, also dominated by broad-leaved deciduous trees. This wetland area is identified along the southern border of Area B, adjacent to the Grand River, and may be flooded periodically by the Grand River.

Generally, plant communities observed at the site appeared to be vigorous and healthy (normal plant structure, no visual evidence of stress). The growth habits (size, presence of seeds and flowering bodies, and plant density) of the plant communities observed at the site appeared to be normal. Vegetation observed at the site showed no obvious sign of stunted growth or unusual growth patterns. In addition, the overall diversity or species-richness observed within each plant community was indicative of normal plant community succession. In areas with chronically-stressed plant communities, overall plant diversity is often low with only more tolerant plant species being present. Depending upon the length of time that the land has been undisturbed, the resident vegetation of the site is in various stages of the successional process from sparse weedy, invasive herbs and grasses through stages of shrub-dominance, ultimately developing a characteristic "old-field" interspersion of mixed-age trees, shrubs, and grasses.

The plant communities present at the site are expected to provide sufficient cover, food, reproductive habitat, and other resources needed to support a diverse wildlife community. The plant communities are likely to host both permanent and migratory wildlife species found throughout southwest Michigan. Bird and mammal species

observed at the site include: morning dove, American robin, black-capped chickadee, house sparrow, European starling, American crow, blue jay, northern cardinal, common flicker, raccoon, beaver, white-tailed deer and eastern cottontail.

Surface Water Contamination

The Ionia City Landfill is bordered on two sides by fresh water surface streams. The landfill is bordered on the east by the Kanouse Drain and wetland and on the south by the Grand River. The Kanouse Drain and wetland is ephemeral except for a small portion of the drain located a few meters upstream of the Kanouse Drain and wetland-Grand River confluence. The Kanouse Drain is a man-made ditch which serves as a drainage way for storm-water runoff from areas north of the former Ionia City Landfill site.

Originating in Jackson County, Michigan, the Grand River has a total drainage area of 2,840 square miles (USGS, 1993) and discharges into Lake Michigan at Grand Haven, in the central area of Western Michigan. Near the landfill, the river is approximately 185 feet wide and 12 feet deep. The Grand River and the Kanouse Drain are State-protected surface water bodies. There have been disagreements between the PRPs and the MDEQ over whether the Kanouse Drain is a state-protected surface water body. As defined in MDEQ's Part 4 Water Quality Standards "surface waters of the state" means all of the following, but does not include drainage ways and ponds used solely for wastewater conveyance, treatment, or control;

- the Great Lakes and their connecting water.
- all inland lakes
- rivers
- streams
- impoundments
- open drains, and
- other surface bodies of water within the confines of the state.

The Kanouse Drain was constructed in the 1920's to deal with surface water/storm water run off. The drain currently collects approximately one-third of the City of Ionia's storm water run off and is not used, nor was it constructed solely for the conveyance of wastewater. Given this information and the definition in Part 4, U.S. EPA agrees with MDEQ's assertion that the Kanouse Drain is a protected surface water body. The PRPs have not disagreed that the Grand River is state-protected water body.

Surface water sampling was conducted in March 1987 to determine whether contamination had occurred as a result of surface water run-off, air transport, or shallow subsurface migration from the Ionia City Landfill. N-nitrosdiphenylamine was the only organic compound identified above its detection limit of 10 µg/l. The semi-volatile compound was identified in one of the Grand River samples adjacent to the site at a concentration of 26 µg/l.

All samples had consistently higher values for calcium, magnesium, and sodium than the upgradient Grand River sample. However, the highest values were generally observed in the upstream drainage ditch samples.

Calcium, magnesium, and sodium were identified in the upgradient Grand River sample at levels of 75,000, 20,800, and 13,000 µg/l, respectively. Silver was also observed in this sample at its detection limit of 10 µg/l.

The three Grand River samples obtained adjacent to or downstream of the site contained calcium, magnesium and sodium at levels ranging from 82,500 to 92,400 µg/l, 21,800 to 24,900 µg/l and 14,200 to 17,400 µg/l, respectively. Cadmium was also observed in two of the samples at concentrations of 9 and 10 µg/l.

The upstream Kanouse Drain samples contained calcium and sodium at concentration ranges of 104,000 to 122,000 µg/l and 75,100 to 80,000 µg/l, respectively. Potassium was observed in these samples at concentrations ranging from 5,550 to 5,900 µg/l, and lead was observed in sample 025-03 at a concentration of 36 µg/l.

The Kanouse Drain samples which were taken adjacent to the site contained calcium at levels ranging from 100,000 to 124,000 µg/l.

In May 1982 the U.S. EPA collected surface water and sediment samples from the Kanaouse Drain. Analytical results of the surface water samples indicated that organic contaminants appeared to be present. Samples were taken at four stations in the Kanouse Drain. Stations I and II were due east of the source area, Station III was near the recreational trail, and Station IV was where the drain meets the Grand River. Methylene chloride was detected at Stations I, II, and III at concentrations of 11, 11, and 10 µg/l, respectively. At Station III, 1,1 dichloroethane was detected at 13 µg/l, 1,2 dichloroethylene was detected at 42 µg/l, and vinyl chloride was detected at 23 µg/l. 1,2-Dichloroethylene was also detected at Station IV at 14 µg/l. Of the metals, only iron, lead and manganese exceeded U.S. EPA water quality criteria.

Ground-water Contamination

A VOC plume is presently discharging from the landfill to the Grand River; however, no evidence of adverse impacts to the river and sediments has been identified.

The types of VOCs present and their concentrations are greatest near the former source area and are significantly reduced as the plume migrates downgradient and eventually discharges to the river. Mixing and dilution of the groundwater, as well as advection, dispersion and retardation factors strongly influence the concentration of the VOC plume, but cannot account for the fewer types of VOCs found near the river. Microbiological populations in the A-1 aquifer may be actively transforming the VOC plume prior to discharge to the Grand River, and continue to transform the VOCs after entering the river.

A summary of groundwater samples collected from August 1992 through June 1995 is shown in Table 1.

Table 1 - Summary of Groundwater VOC Samples

Contaminant	Maximum Concentration 1992 - 1995 (µg/l)	Maximum Concentration 1999 (µg/l)
Vinyl Chloride	190	640**
Chloroethane	1,400	Not Detected
Methylene Chloride	93,000	Not Detected
1,1-Dichloroethene	83	2
1,1-Dichloroethane	1,400	260
cis-1,2-Dichloroethene	5,600	3,400*
1,1,1-Trichloroethane	410	340
Trichloroethene	8,200	7,400*
Toluene	640	3

* Found in PMW-1 near previously excavated source area
** Found in PZ-18D at southwest corner of Area A and just downgradient from the previously excavated source area

A detailed analysis of groundwater contaminant trends was submitted by the PRPs in January 2000, and can be found in the Administrative Record. Trichloroethene, cis-1,2 dichloroethene, and vinyl chloride are discussed in detail below. The locations of the various monitoring wells are shown in Figure 4. Figure 5 shows the distribution of Total VOCs in groundwater.

Trichloroethene

Results of the trend analysis for trichloroethene (TCE) indicate that concentrations in PMW-1 are increasing slightly, while concentrations in PMW-5 and PMW-2 are decreasing slightly. A correlation between groundwater elevation fluctuations and concentrations can be seen only in PMW-2. PMW-1, PMW-2 and PMW-5 are all located in the immediate vicinity of the former point-source area.

Results of the trend analysis for TCE indicate a trend of decreasing concentrations in the areas of PZ-21S, PZ-21D, PMW-3, PMW-4 and PZ-18S. No correlation between groundwater elevation fluctuations and concentrations of TCE is apparent in any well

exhibiting a decreasing trend. OW-21 analysis indicates a stable trend over its sampling history. PMW-3 and PMW-4 are in the immediate area of the former point-source. OW-21, PZ-21S and PZ-21D are located in the southeast portion of Area A just west of the Kanouse Drain. PZ-18S is located in the southwest portion of Area A just north of the recreational trail.

Analytical data indicate TCE was detected in OW-18 and OW-19 during two sampling events at concentrations of 32 µg/l and 20 µg/l for OW-18 and 170 µg/l and 135 µg/l in OW-19. However, two data points are insufficient for further trend analysis. Both OW-18 and OW-19 are located south of the former source area and just north of the recreational trail. Analytical data for all other sample points, farther south in Area B, west of Cleveland Street and near the Grand River, did not indicate concentrations of TCE above the method detection limit.

In summary, TCE is still detected in its highest concentrations near the previously excavated point-source area and tend to decrease downgradient of the point-source area, with no detection of TCE near the Grand River. TCE was found at 180 ug/L in well PZ-21 which is between the former point source area and the Kanouse Drain. TCE was not detected in PZ-22 which is on the other side of the Kanouse Drain. Figure 6 shows the concentrations of TCE in February 1999 before the pump and treat system was operational.

cis-1,2 Dichloroethene

Results of the trend analysis prepared by the PRPs for *cis*-1,2 dichloroethene (*cis*-1,2 DCE) indicate a trend of increasing concentrations in the areas of MW-8, PMW-4, PZ-18D, PZ-18S and PZ-19S. A correlation between concentrations of *cis*-1,2 DCE and fluctuations in groundwater elevation is apparent in MW-8, PMW-4 and PZ-19S. No correlation between fluctuations of groundwater elevation and concentrations of *cis*-1,2 DCE is apparent in PZ-18S and PZ-18D. MW-8 is located downgradient, south of the former point-source area. PZ-18D and PZ-18S are located southwest of the former point-source area, just north of the recreational trail. PZ-19S is located due south of the former point-source area. PMW-4 is located just northwest of the former point-source area.

Results of the trend analysis for *cis*-1,2 DCE indicate a generally steady trend of concentrations in MW-7R, PMW-1, PZ-20D, PZ-21D and PZ-21S. No correlation between fluctuations in groundwater elevation and concentrations of *cis*-1,2 DCE is apparent in any well with a steady trend. PZ-21S and PZ-21D are located southeast of the former point source area, just west of the Kanouse Drain ditch along the eastern site border. MW-7R is located just southwest of the intersection of the recreational trail with Cleveland Street. PZ-20D is located in the northern portion of Area B of the site.

Results of the trend analysis for *cis*-1,2 DCE indicate a decreasing trend in the areas of PMW-2, PMW-3, PMW-5, MW-4, MW-15, OW-21 and OW-22. PMW-5 and PMW-2

each had the results from one sample event flagged by the laboratory due to the presence of *cis*-1,2 DCE in the quality control blank. A likely correlation between groundwater elevation fluctuations and concentrations of *cis*-1,2 DCE is apparent in OW-21 and PMW-5. No correlation between groundwater elevation fluctuations and concentrations of *cis*-1,2 DCE is apparent in PMW-2, OW-22, PMW-3, MW-15 and MW-4. PMW-2, PMW-3 and PMW-5 are located in the immediate area of the former point-source area. OW-21 and OW-22 are located in the southeast portion of Area A of the site. MW-4 is located in the northeast portion of Area B, of the site, while MW-15 is located to the far southwest of the site.

Analytical results for OW-18 indicate the presence of *cis*-1,2 DCE at concentrations of 120 µg/l and 62 µg/l on two separate occasions. Analytical data for OW-19 indicate the presence of *cis*-1,2 DCE at concentrations of 66 µg/l and 68 µg/l during two sample events. Results for OW-20 indicate concentrations of *cis*-1,2 DCE at 5 µg/l during two sample events. However, two data points are insufficient for further trend analysis. Analytical data for OW-23 indicate concentrations of *cis*-1,2 DCE at 335 µg/l during one sample event. Analytical results for PZ-23 reported concentrations of *cis*-1,2 DCE at 6 µg/l during one sample event. However, one data point is insufficient for further trend analysis. Analytical results for all other sample points did not indicate concentrations of *cis*-1,2 DCE above the laboratory detection limit.

In summary, *cis*-1,2 DCE is detected in its highest concentrations just slightly downgradient of the former point-source area and tends to decrease farther downgradient of the point-source area. Low levels of cis-1,2 DCE, (6 µg/l) was found at MW-15, but drop off to non-detect just a little farther downgradient near the Grand River. Cis-1,2 DCE was found at 27 µg/l at MW-13R where the Kanouse Drain enters the Grand River. Figure 7 shows the concentrations of *cis*-1,2 DCE in February 1999 before the pump and treat system was operational.

Vinyl Chloride

Results of the trend analysis for vinyl chloride indicate a trend of increasing concentrations in the areas of OW-22, PZ-18S, PMW-1, MW-4 and PZ-18D. A correlation between groundwater elevation fluctuations and concentrations of vinyl chloride is apparent only in OW-22. PZ-18S is located in the southwest portion of Area A, northeast of the intersection of the recreational trail with Cleveland Street. MW-4 is located in the northeast corner of Area B. PZ-18D is in Area A just northeast of the intersection of the recreational trail with Cleveland Street. PMW-1 is located in the immediate area of the former point-source.

Results of the trend analysis for vinyl chloride indicate a trend of generally steady concentrations in the areas of MW-7R and MW-10R. No correlation between groundwater elevation fluctuations and concentrations of vinyl chloride is apparent. MW-10R is located near the southwest corner of Area B and is slightly west of Cleveland Street. MW-7R is located just slightly southwest of the intersection of the

recreational trail with Cleveland Street.

Results of the trend analysis for vinyl chloride indicate a trend of decreasing concentrations in the areas of MW-13R, PZ-21S, PZ-21D, PZ-19S, MW-15, OW-21 and PZ-20D. A correlation between groundwater elevation fluctuations and concentrations of vinyl chloride is only apparent in OW-21. OW-21, PZ-21S and PZ-21D are located in the southeast portion of Area A near the Kanouse Drain. PZ-20D is located in the northwest corner of Area B, east of Cleveland Street. PZ-19S is located in Area A just north of the recreational trail. MW-13R is located in the extreme southeast corner of Area B just north of the Grand River. MW-15 is located far to the southwest of the site, west of Cleveland Street.

Laboratory analytical data indicate the presence of vinyl chloride during one sample event in MW-8 at 2 µg/l, in OW-18 at 75 µg/l and at 160 µg/l in OW-23. However, one data point is insufficient for further trend analysis. Analytical results for all other sample points did not indicate concentrations of vinyl chloride above the method detection limit.

In summary, vinyl chloride is detected in its highest concentrations just slightly downgradient of the former point-source area and tends to decrease farther downgradient of the point-source area like *cis*-1,2 DCE. However vinyl chloride concentrations are much lower than *cis*-1,2 DCE. Low levels of vinyl chloride, 3 µg/l at MW-15, are found nearest the Grand River. Vinyl Chloride was found at 6 µg/l at MW-13R where the Kanouse Drain enters the Grand River. Figure 8 shows the concentrations of vinyl chloride in February 1999 before the pump and treat system was operational.

Point Source Investigation, Evaluation and Removal

A point source investigation was performed by the PRPs at the Ionia City Landfill to identify the waste quantities, locations, components, contaminants, and compositions. The investigation consisted of several activities including the following:

- On-site subsurface soil sampling,
- Magnetometer survey,
- Trenching, and
- Clay cap analysis.

Additional activities associated with the point source included:

- ISV evaluation and site preparation, and
- Point source removal.

Magnetometer Survey

A magnetometer survey was conducted at the Ionia City Landfill during the week of March 3, 1987. The purpose of the survey was to locate possible areas of buried ferrous metals within the boundaries of the landfill.

The magnetometer survey was performed over the entire landfill, with total magnetic field and gradient measurements being collected every twenty-five feet along north-south survey lines. Further delineation of selected anomalies was provided by collecting measurements at twelve and one-half foot intervals.

Interpretation of the data indicated that the largest anomaly occurred in the north-central portion of Area B and was coincident with the largest magnetic gradients. Large gradients also were recorded toward the railroad track, but many of the high values in this area corresponded to metal debris at the surface. Another large anomaly occurred near the margin of the landfill in the northern portion of Area A.

Eight of the ten trenches contained municipal/ commercial/construction trash, including metal debris (rebar, wire, etc.) which apparently generated the magnetic anomalies. Drums were discovered within two of the trenches located in Area A. Consequently, the magnetometer data generated from the northern portion of Area A were further evaluated to define the limits of the magnetic anomalies.

Trenching

Trenching activities at the Ionia City Landfill were conducted during two separate events. The first trenching event, which consisted of ten excavations throughout Areas A and B, occurred during the week of April 29, 1987. The second trenching event occurred during the week of November 16, 1987 and consisted of fourteen excavations within Area A. The purpose of the investigations was to define and characterize the landfill mass.

First Trenching Event

Preliminary trenching locations were based upon the results of the magnetometer survey, a review of aerial photographs, and a visual survey of surface features. Six trenches were excavated in Area B and four trenches in Area A. Materials exhumed from the Area B trenches consisted of municipal/facility debris; no chemical or hazardous waste was encountered. Likewise, two of four Area A trenches contained debris characteristic of a municipal landfill. However, the two trenches located near the north boundary of the landfill mass contained drums.

Second Trenching Event

The second trenching event was performed during the week of November 16, 1987, to further delineate boundaries of drummed waste within Area A.

Using the horizontal boundary data from the geophysical evaluation, a series of trenches were excavated in the northern portion of Area A to locate the west, south, and southeast boundaries of the drum waste. A total of fourteen (14) trenches were investigated during the second event. The trenches located at the horizontal boundaries were excavated to the vertical limits of the drum deposits. The length of the trenches ranged from 15 to 50 feet. Additional shallow trenches were excavated within the estimated interior of the drum deposit area in order to confirm the presence of drums between the boundary trenches. The depth of excavation for these trenches was only to the top of the drum deposit.

The majority of the drums encountered were in a badly deteriorated condition and were partially full or empty with the waste having intermixed with the surrounding sandy soil. The wastes observed were primarily solid materials such as paint residue/sludges, gel thickener, and resins. Several intact drums containing liquids were excavated towards the western limits of the trench.

Generally, the containers were encountered below a clay-like cover layer ranging in thickness from 2-3 feet. The majority of the containers were 55 gallon steel drums which appeared to be placed randomly within a trench oriented in an east-west direction. The drums, intermixed with a sandy soil, ranged in depth from 2-10 feet.

Some drums were broken and the contaminated liquid contents were released to the excavation pit and the groundwater during the removal process. The exhumed drums and associated wastes were placed back into the trench and recompacted with the backhoe bucket. The clay-like cover which was initially segregated during the excavation process was placed over the backfilled trench.

Cap Investigation

The analysis of the landfill cap was conducted May 27-28, 1987. The purpose of this investigation was to determine the extent and physical characteristics of the existing cap.

The results of the field observation of the Landfill Clay Cap Investigation indicated two types of cover. The first type, characterized by a clay rich texture, was very localized and existed only on top of the buried drum trench in Area A. The second type of sediment is also characterized by its texture; however, this material ranged from a silty sand to a gravely sand.

A summary of observations and conclusions of the landfill cover in 1989 are as follows:

- Area A was grass covered, except for the drum area, which was covered with a two (2) foot layer of clay.
- The majority of the landfill mass associated with Area B was also covered with vegetation; however, there were pedestrian and vehicular roads that

were bare (unvegetated) which could result in the generation of dust during dry windy conditions and/or the exposure of waste mass due to degradation of the soil cover.

- Debris was exposed along the east and south slopes of Area B.

Waste Characterization

The point source investigation resulted in a more complete characterization of the Ionia City Landfill. The magnetometer survey, although successful in determining the areas which exhibited buried metals, did not differentiate buried drums from other types of metals. However, the trenching activities were successful in delineating the boundaries of buried wastes. Furthermore, analyses of samples obtained from the trenches allowed the areas to be chemically classified.

The trenching activities were successful in delineating the boundaries of the landfill area, thus estimating the types and quantities of buried wastes. Based upon the results of the trenching activities it was determined that the buried wastes at the Ionia City Landfill consisted of both industrial wastes and non-industrial (municipal) wastes. From measurements obtained from the trenching logs, it was estimated that approximately 335,975 cubic yards of total waste were located at the landfill. Of that total, approximately 4,881 cubic yards consisted of industrial waste (i.e. the point source), while the remaining (331,094 cubic yards) consisted of municipal and commercial debris.

Based on the trench logs, Area A contained an estimated 146,383 cubic yards of waste. Of that total approximately 4,881 cubic yards consisted of the drum waste within the trench discovered along the northern perimeter of the landfill mass. The material in this trench consisted of 55 gallon steel drums, dried paint sludges, various organic materials, and sand. The western end of the trench also contained solvent filled drums. Additionally, three non-intact drums, observed towards the eastern limits of the area during the initial trenching, contained a liquid material. The remaining 141,502 cubic yards apparently consisted of municipal and commercial debris. The analytical data indicate that the organic contaminants are confined to the drum trench.

Based on the trench logs, Area B contained an estimated 189,590 cubic yards of waste which consisted of municipal and commercial debris. Observations of the contents of the Area B trench excavations did not indicate the presence of chemical waste. This observation was confirmed by the analysis of samples from the six Area B trenches.

Point Source Evaluation

The 1989 selected remedy for the point source was In-situ Vitrification (ISV). A 3/3/91 incident during one of Geosafe's (the sole contractor for ISV) operational acceptance tests at another site resulted in a delay and reevaluation and applicability of ISV to the Ionia City Landfill.

Additional trenching within the point source was conducted in November of 1991. The purpose of the trenching was to obtain a representative sample of the point source for a treatability study, as well as to allow Geosafe to evaluate the applicability of the point source waste for ISV in light of their 3/3/91 incident.

The ISV treatability test was successfully performed on the contaminated soils from the point source. However, after an evaluation of the technology relative to the Ionia site conditions Geosafe required the removal of intact and non-intact drums containing quantities of liquids and elimination of voids or spaces in the waste mass prior to ISV processing. Therefore, to ensure safe and efficient implementation of the ISV remedy, during the fall/winter of 1992, the PRPs, with oversight by U.S. EPA, removed contained liquids in the point source area were removed and treated/disposed of them at off-site facilities. Additionally, debris and materials were reduced in size and spread throughout the excavation during backfilling. The point source area was subsequently covered with a geomembrane to prevent infiltration of rainwater. As a result of these ISV site preparation activities, the estimated volume of the waste in the point source area was revised to 6,000 cubic yards.

Subsequent to the evaluation of the November 1993 groundwater sampling data, U.S. EPA requested that the PRPs submit a specific proposal to address shallow groundwater contamination. In response to this request, a proposal was submitted to U.S. EPA on April 28, 1994, for implementing a removal action to contain the impacts detected downgradient of the point source. In addition, the proposal also included additional excavation and off-site disposal of impacted soils and wastes in the point source area at a RCRA-approved, CERCLA-compliant disposal facility. The proposal was accepted with modification by the U.S. EPA.

A September, 1994, Work Plan was approved by U.S. EPA for the point source removal activities in October 1994. This Work Plan was incorporated in the Administrative Order issued on October 24, 1994. Mobilization for the point source removal action occurred during the week of October 17-24, 1994, and removal of the point source commenced on October 25, 1994, and continued through December 8, 1994. During this period, approximately 12,267 tons of waste material and contaminated soils were excavated, transported off-site, and disposed at a RCRA-approved, CERCLA-compliant facility. Of the 12,267 tons, approximately 3,743 tons were RCRA-characteristic for lead and required treatment prior to disposal.

Clean sand obtained from an off-site source was used to backfill the excavation and an 18-inch cap composed of clay/clay-rich material was placed over the sand backfill. In spring 1995, site restoration, which included the application of topsoil and a perennial seed mixture suitable to the regional climate, was completed.

No other known sources exist in Area A or B of the landfill.

F. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Uses

The City of Ionia has no plans to develop any part of the site for residential purposes and institutional controls, as part of this ROD, would prohibit residential development. The City of Ionia has been approached by a potential buyer, for Area B, and there is the potential for future industrial/commercial development of the northern portions of Area B. However, the site is situated within the floodplain of the Grand River and any future use or development of the site would have to incorporate restrictions imposed by floodplain regulations.

Surface Water / Ground-Water Uses

Located along the eastern boundary of the landfill, the Kanouse Drain drains into the Grand River to the south. It was constructed in 1926 and was created under the authorities of the Ionia County Drain Commissioner. It currently collects approximately one-third of the surface water in the city. It is regularly cleaned and maintained by the City of Ionia. Flow through the Kanouse Drain is intermittent.

Located along the southern boundary of the landfill is the Grand River. Near the landfill, the river is approximately 185 feet wide and 12 feet deep. The river provides sport fishing and other recreational activities.

Neither the Kanouse Drain nor the Grand River are current drinking water sources, and the Michigan Department of Public Health and the City of Ionia preclude the installation of a drinking water wells at or near the site. Michigan Public Health Code Act 368, as amended and its Administrative Rules preclude the placement of a drinking water well at or near the site. Flow in the Kanouse Drain is intermittent and could not be reasonably anticipated as a future drinking water source. Flow in the Grand River is large enough that it could potentially be used as a future drinking water source.

Area B of the landfill extends to the Grand River and the contaminant plume extends to the River.

G. SUMMARY OF SITE RISKS

The risk assessment estimates what risks the site poses, if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen.

Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where:

risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over 30 years (mg/kg-day)
SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in a million chance of developing cancer as a result of site-related exposure. This is referenced as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other cancer causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site related exposures is 10^{-4} to 10^{-6} (1 in ten thousand to 1 in a million).

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effects. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemicals of concern that affect the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI>1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI} / \text{RfD}$$

where:

CDI = Chronic daily intake
RfD - reference dose

CDI and RfD are expressed in the same units and represent the same exposure period.

Summary of Human Health Risks

Identification of Contaminants of Concern

The purpose of identifying chemicals of concern (COC) is to focus the risk assessment on those chemicals which may pose a potential health risk. The U.S. EPA considered the following factors in the COC selection process: 1) comparison of maximum site inorganic chemical (metals) concentrations to Michigan specific background concentrations as presented in MDEQ Operational Memoranda #15 (1993) and #18 (1999); 2) whether the detected chemical is an essential nutrient (*i.e.*, calcium, magnesium, potassium, and sodium); 3) comparison of site maximum chemical concentrations to appropriate health-based screening levels (*i.e.*, Region IX Preliminary Remediation Goals (PRGs; U.S. EPA, 1998); and 4) if the detected chemical is one of the 11 COCs identified in the original Endangerment Assessment conducted in 1988. Exposure point concentrations (EPCs) are identified for chemicals identified as COCs based on the aforementioned COC selection process. EPCs are calculated for relevant environmental media at the site (i.e., soil, surface water, sediment, air and fish). Since there is no planned human use of groundwater, groundwater data are not evaluated in this assessment. As discussed earlier, a groundwater treatment system (air stripper) is currently in operation in Area A. Therefore, risks associated with the potential release of volatile organic compounds (VOCs) from this operation are also evaluated in this assessment. Concentrations of VOCs potentially released to the environment are derived according to MDEQ methodology.

Table 2 - 1988 Endangerment Assessment Contaminants of Concern			
butyl benzyl phthalate	cadmium	chromium	1,1-dichloroethane
trans-1,2-dichloroethene	1,2-dichloroethene	manganese	methylene chloride
selenium	silver	1,1,1-trichloroethane	

Based on the new screening, the following chemicals were added to the revised risk assessment:

Table 3 - Additional Contaminants of Concern From the 2000 Human Health Risk Assessment*			
aluminum	arsenic	barium	benzene
benzo(a)pyrene	cis 1,3-dichloropropene	iron	lead
n-nitrosodiphenylamine			

* copper was found in concentrations exceeding the MDEQ GSI criteria.

Background Comparison

Certain concentrations of metals are present naturally in the earth's crust and are referenced as "background" concentrations. Consistent with U.S. EPA (1989) guidance, if a metal concentration in a particular medium does not exceed background concentrations in media "native to the property", the metal should not be quantitatively evaluated in a risk assessment. Accordingly, Michigan background concentrations of metals in soils based on MDEQ Operational Memoranda #15 (1993) and #18 (1999) were compared to maximum site soil metal concentrations and to maximum site-related sediment concentrations to determine if the concentrations were greater than background.

Essential Nutrients

Consistent with U.S. EPA (1989) guidance, metals detected at the site which are considered to be essential human nutrients are eliminated from further consideration.

> "Chemicals that are (1) essential human nutrients, (2) present at low concentrations (*i.e*, only slightly elevated above naturally occurring levels), and (3) toxic only at very high doses (*i.e.* much higher than those that could be associated with contact at the site) need not be considered further in the quantitative risk assessment. Examples of such chemicals are iron, magnesium, calcium, potassium, and sodium."

Accordingly, magnesium, calcium, potassium, and sodium were not included as COCs in this risk assessment. Iron was retained as a COC since site concentrations exceed background and PRGs.

Human Health Screening Criteria

Maximum site concentrations were compared to appropriate health-based screening levels (*i.e.*, Region IX Preliminary Remediation Goals ([PRGs]; U.S. EPA, 1998). The U.S. EPA (1998) Region IX soil PRGs for residential and industrial scenarios were used to screen the site soil and sediment chemical concentrations. For surface water, the U.S. EPA (1998) Region IX tapwater PRGs are used. The PRGs are based on upper-bound exposure assumptions, and therefore are a conservative screening criteria. The Region IX PRGs were multiplied by 0.1 for potential additivity of noncarcinogenic chemicals. Chemicals not exceeding the Region IX PRGs were eliminated from further consideration.

Exposure Assessment

Exposure assessment is the process of estimating the magnitude, frequency, duration, and type of potential exposures to site-related chemicals. Two exposure levels are

quantified in the analysis for the site: (1) the most likely exposure (MLE); and (2) the reasonable maximum exposure (RME). By examining these two levels of exposure, a range of possible exposures were available The MLE is used to represent the median or average exposure in a given population and is typically calculated using median or average values for exposure parameters and concentrations of COCs in environmental media. The RME is defined by the U.S. EPA as the highest exposure that is reasonably expected to occur at a site. It should be noted that the intent of the RME is to provide a conservative estimate of exposure that is well above the average exposure but still within the range of possible exposures. The RME is typically determined by using upper bound estimates (*i.e.*, the 95% UCL of the arithmetic mean) for exposure parameters and concentrations of COCs in environmental media.

Identification of Exposure Scenarios

Potential exposure scenarios are evaluated based on current and reasonable future activities and land uses at and near the site. Populations that may potentially be exposed to site-related chemicals in environmental media include off-site residents who live near the site and potentially future on-site workers. Per City of Ionia representatives, there are no plans to develop any part of the site for residential purposes in the future and appropriate administrative controls will be implemented to protect future on-site workers.

As discussed in the EA, shallow groundwater is not currently used, nor expected to be used in the future, as a source of potable water. In addition, the City of Ionia and the Michigan Department of Public Health preclude the installation of a drinking water well at or near the site. If portions of Area B are developed for commercial/industrial purposes in the future, excavation workers are not expected to come into contact with groundwater because the depth of the excavation area is not expected to be more than 10 feet and the water table is at least 12 feet below ground surface in the potential development area. For these reasons, exposures to groundwater are not evaluated in the revised human health risk assessment.

The northern portion of the site (Area A) is currently inactive and is not expected to be developed for commercial/industrial purposes in the foreseeable future although at the City of Ionia has recently expressed on interest in potential redevelopment opportunities for some portions of Area A. A worker scenario has not been evaluated for Area A but would need to be evaluated if development of Area A was to be seriously considered.

Furthermore, trespassing is possible, although Area A is currently fenced. Exposure assumptions (exposure frequency, duration and pathways) used to evaluate the current resident adult scenario would be protective of a worker who is required to visit the site (Areas A and B) briefly for maintenance purposes, or of a trespasser.

There is certainly a greater potential that Area B may be developed in the future under the State of Michigan Brownfields Program for industrial or commercial purposes only.

A future general worker and excavation worker were evaluated for Area B. However, U.S. EPA is recognized that the current data set used to develop the future general worker and excavation worker exposure assessment may not be adequate to address all concerns with future site specific development. The City of Ionia and any future developer will explore the potential for commercial/industrial development of the site. The City of Ionia, upon notification to U.S. EPA and MDEQ of any plans for site development, will amend the human health risk evaluation as necessary to address the site specific development as it relates to the site specific conditions. This approach will help assure that any future sampling that may be necessary to further address exposures will be focused on the area and specific nature of site use and development. In addition, a resident child and a resident adult who visit the site are also evaluated. Two exposure pathways which were not evaluated in the 1989 Endangerment Assessment (*i.e.*, inhalation of soil particulates and dermal contact with surface water) are included in this assessment. Fish ingestion is considered as a separate pathway since this activity may be conducted by a small subset of area residents, visitors, or workers. Potentially complete exposure pathways for the four scenarios evaluated are summarized in Table 4.

Table 4 - Complete Exposure Pathway Summary

	Worker		**Resident**	
Medium	**General**	**Excavation**	**Adult**	**Child**
Soil (Areas A & B)	NA	NA	Ingestion Dermal Contact **Inhalation (particulates)**	Ingestion Dermal Contact **Inhalation (particulates)**
Area B Soil	Ingestion Dermal Contact **Inhalation (particulates)**	Ingestion Dermal Contact **Inhalation (particulates)**	NA	NA
Surface Water	NE	NE	Ingestion **Dermal Contact**	Ingestion **Dermal Contact**
Sediment	Dermal Contact	NE	Dermal Contact	Dermal Contact
Fish*	NE	NE	Ingestion	Ingestion
Air	Inhalation (volatile emissions)	Inhalation (volatile emissions)	Inhalation (volatile emissions)	Inhalation (volatile emissions)

NA Not applicable.
NE Not evaluated; no exposure.
Bold indicates pathway not evaluated in the 1989 Endangerment Assessment.
* Fish ingestion evaluated separately for an adult and child.

Toxicity Assessment

The purpose of the toxicity assessment is to evaluate the toxicity of site-related COCs and to identify an estimate of the dose-response relationship for each of these chemicals. The two principle indices of toxicity used in risk assessment are the reference dose (RfD) and the cancer slope factor (SF). The RfD is the daily intake or dose per unit of body weight (mg/kg-day) that is unlikely to result in toxic (noncarcinogenic) effects to exposed human populations, including sensitive subgroups. The RfD assumes the existence of a threshold below which no adverse effects occur.

The SF is used to express the cancer risk attributable to a discrete unit of intake, that is, the cancer risk per milligram ingested per kilogram of body weight per day [$(mg/kg\text{-}day)^{-1}$]. The SF is an estimate of the upper-bound probability of an individual developing cancer as a result of exposure to a particular carcinogen. Unlike the RfD, the SF assumes that there is no threshold dose below which the risk of developing cancer is zero. Note that SFs are only developed for those chemicals that have been shown to be carcinogens in humans or at least in one or more animal species. A carcinogenic weight of evidence rating is used to describe the strength of the experimental evidence for carcinogenicity (A = known human carcinogen; B1/B2 = probable human carcinogen; C = possible human carcinogen; D = not classifiable; E = no evidence of carcinogenicity).

RfDs and SFs are derived by the U.S. EPA for chemicals that have an adequate toxicological database. If both the carcinogenic and noncarcinogenic effects of a particular compound are significant, both RfD and SF values are established, and the risk from both the noncarcinogenic and carcinogenic effects of the compound can be assessed. The toxicological criteria for COCs identified in environmental media at the site are summarized in human health risk assessment in the administrative record.

Risk Characterization

Cancer Risk Estimates

The chemical-specific, pathway-specific, and total cancer risk estimates for the future General and Excavation Workers and the current Resident Adult and Fish Ingestion scenarios are presented in the administrative record and are summarized below.

General Worker Scenario

The potential cancer risk estimates for a General Worker exposed to Area B soil (incidental ingestion, dermal contact, and inhalation of particulates), sediment (dermal contact), and air (inhalation of volatile emissions) are 9×10^{-7} and 1×10^{-5} for the MLE and RME evaluations, respectively. The RME cancer risk estimate falls within the NCP

risk range of 1 x 10^{-6} to 1 x 10^{-4}. Ingestion of arsenic comprises virtually all (90.3%) of the RME cancer risk estimate. Cancer risk estimates for all other chemicals and pathways are below the risk level of 1 x 10^{-6}. See Human Health Risk Table 1.

Excavation Worker Scenario

The potential cancer risk estimates for an Excavation Worker exposed to Area B soil (incidental ingestion, dermal contact, and inhalation of particulates) and air (inhalation of volatile emissions) are 2 x 10^{-7} and 4 x 10^{-7} for the MLE and RME evaluations, respectively. Potential cancer risks associated with all chemicals and pathways are below the risk level of 1 x 10^{-6}, indicating that potential cancer risks are not significant for this scenario. See Human Health Risk Table 2.

Resident Adult Scenario

The potential cancer risk estimates for a Resident Adult exposed to soil (incidental ingestion, dermal contact, and inhalation of particulates), surface water (incidental ingestion and dermal contact), sediment (dermal contact), and air (inhalation of volatile emissions) are 1 x 10^{-6} and 9 x 10^{-6} for the MLE and RME evaluations, respectively. The RME cancer risk estimates fall within the NCP risk range of 1 x 10^{-6} to 1 x 10^{-4}. Ingestion of arsenic in soil and inhalation of vinyl chloride comprises the majority (i.e., >93%) of the RME cancer risk estimate. However, potential risks associated with arsenic do not take into account the contribution from background levels. The concentration of arsenic in the single background shallow subsurface soil sample collected during the RI/FS was 15 mg/kg. Site-related concentrations of arsenic at surface level (i.e., 13 and 16.8 mg/kg for MLE and RME, respectively) are similar to this background concentration. Thus, potential risks associated with exposure to arsenic are likely due to background levels. Potential risks for residents due to exposures to volatile emissions from the air stripper are calculated for the residential area located approximately 300 feet northwest of the air stripper. The nearest residential area is located north of the site, approximately 650 feet north of the air stripper. For the residential exposures to volatile emissions from the air stripper, an exposure time of 24 hours/day for 350 days/year is conservatively assumed for exposures occurring at home. This assumption assumes that, with the exception of two weeks per year, residents never leave their home (*e.g.*, to work, shop, etc.) and does not take into account the MLE and RME exposure times (1 and 2 hours/day for 50 and 100 days/year) for exposures occurring at the site (along the bike path). See Human Health Risk Tables 3 and 4.

Fish Ingestion Scenario

The potential cancer risk estimates for the Adult Fish Ingestion scenario are 2 x 10^{-6} and 8 x 10^{-6} for the MLE and RME evaluations, respectively and fall within the NCP risk range of 1 x 10^{-6} to 1 x 10^{-4}. Ingestion of arsenic and n-nitrosodiphenylamine in fish

comprises the majority of the risk from fish ingestion. As previously mentioned, the adult fish ingestion scenario is conservative and assumes that all of the fish consumed by the adult are from the site. It is also important to note there was only one detection of n-nitrosodiphenylamine out of six surface water samples collected, and therefore, the risk is being driven by one surface water sample. Also, the risk due to arsenic can be partially attributed to naturally occurring background concentrations. See Human Health Risk Table 5.

Human Health Summary

As discussed earlier, potential noncancer risk estimates (HIs) are below the regulatory benchmark of 1 for all scenarios except the excavation worker, the resident child and fish ingestion; and potential cancer risk estimates are below the risk level of 1×10^{-6} for all scenarios except the resident adult, general worker, and fish ingestion, as summarized in Table 5. See Human Health Risk Tables 6 - 11.

TABLE 5 - SUMMARY OF HUMAN HEALTH RISKS

	HI		Cancer Risk Estimate	
Scenario	**MLE**	**RME**	**MLE**	**RME**
General Worker	0.2	0.3	9×10^{-7}	1×10^{-5}
Excavation Worker	1.0	2.0	2×10^{-7}	4×10^{-7}
Resident Adult	0.08	0.2	1×10^{-7}	9×10^{-6}
Resident Child	0.5	2.0	NA	NA
Adult Fish Ingestion	0.7	2.0	2×10^{-6}	8×10^{-6}
Child Fish Ingestion	2.0	4.0	NA	NA

NA - Not applicable.

It should be noted that further investigation of Area B would be needed if brownfield redevelopment as an industrial/commercial facility is considered in the future.

Specifically, it is recognized that the current data set used to develop the future general worker and excavation worker exposure assessment may not be adequate to address all concerns with future site specific development. The City of Ionia and any potential developer must explore the potential for commercial/industrial development of the site. The City of Ionia, upon notification to U.S. EPA and MDEQ of any plans for site development, will amend the human health risk evaluation as necessary to address the site specific development as it relates to the site specific conditions. This approach will help assure that any future sampling that may be necessary to further address exposures will be focused on the area and specific nature of site use and development.

As an example, if a VOC plume still exists in the proposed development area, the possible risk of volatile contaminants entering buildings and accumulating in indoor air may need to be evaluated so that preventative measures could be incorporated into the building design.

Uncertainty Analysis

The purpose of this section is to identify and discuss areas of uncertainty associated with the quantitative estimates of risk presented at the site. This discussion serves to place the risk estimates in proper perspective by fully specifying the assumptions and uncertainties inherent in the assessment (U.S. EPA, 1989a). The key variables and assumptions are identified that contribute most to the uncertainty. Where there is uncertainty regarding an assumption, a conservative estimate has been chosen to ensure that the assessment will be health-protective. Uncertainties associated with the four components of risk assessment (Data Evaluation, Toxicity Assessment, Exposure Assessment, and Risk Characterization) are discussed below.

Uncertainty in Data Evaluation and Exposure Assessment

A discussion of the uncertainties introduced by the selection of EPCs and exposure parameter values used in this assessment is provided below.

- *Averaging of Sample Duplicates* - Consistent with U.S. EPA guidance, the results from sample-duplicate pairs are combined (averaged) prior to calculating summary statistics. The average represents the best estimate of the "true" concentration. The net impact of averaging the sample-duplicate pairs serves to underestimate potential risks if the "true" sample concentration lies closer to the maximum result. On the other hand, if the "true" sample concentration lies closer to the minimum result, then the averaging of sample duplicate pairs serves to overestimate potential risks.

- *Biases in the RI/FS Sampling Program* - In general, the sample locations were selected (biased) with the purpose of locating and identifying site-related constituents. As such, these samples are not randomly distributed throughout the site and therefore, are not representative of overall conditions. For this reason, the use of these data for general exposure purposes could overestimate risks. In addition, the only data available to evaluate exposures to Area B soil are from soil samples collected during trenching activities. One sample was collected at a depth of 5 feet and another sample was collected at a depth of 10 feet. The remaining six samples were collected at depths ranging from 15 to 17 feet. Exposures to soil for the general and excavation workers should be limited to the upper 2 and 10 feet of soil, respectively. Chemical concentrations are typically greater at lower depths, especially for VOCs. Therefore, the use of these data for the general and excavation worker scenarios may overestimate risks. Although there is a limited amount of data which may add a certain

amount of uncertainty to the risk assessment, the data is adequate for the scenarios evaluated at the site.

- *Exposure Assumptions* - Conservative default values are used for the resident scenarios (350 days/year, 24 hours/day, etc.) and the worker scenarios (250 [general worker] or 30 [excavation worker] days/year, 8 hours/day, etc.). In addition, upper bound estimates for certain parameters (*e.g.*, inhalation, soil ingestion, and fish ingestion rates), rather than average estimates, are used for the MLE evaluations. These factors will overestimate risks.

- *Degradation* – This assessment assumes no degradative processes that may decrease chemical concentrations over time resulting in an overestimate of exposure for at least organic compounds. This assumption serves to overestimate potential hazards and risks in the future, particularly for compounds that are relatively short-lived, such as vinyl chloride (in air). The half-life for vinyl chloride in air ranges from 9.7 to 97 hours (Howards, 1991). It is important to note that vinyl chloride is a breakdown product of trichloroethylene (TCE). Therefore, as TCE breaks down at the site, this could cause a potential short-term increase in the amount of vinyl chloride in groundwater over time. However, vinyl chloride also degrades with time.

- *Bioavailability* - In general, this assessment looks at bioavailability in two ways: (1) dermal absorption from solids and water; and (2) gastrointestinal absorption. Dermal absorption from water is based on the permeability constant, K_p, of the COC in question and time in contact with the water. K_p values are either literature values or derived via procedures laid out in U.S. EPA guidance. These estimated values are likely to overestimate systemic absorption based on comparison with actual data.

  Dermal absorption of COCs from soil is assumed to be a percentage of the concentration contained in the amount adhering to skin, and this percentage varies with the class of chemical. For instance, only 1% of inorganics from the solid matrix is assumed to be absorbed, while 10% of semi-volatile organics and volatile organics is assumed to be absorbed unless other literature values existed. These values are considered overestimates of the actual absorption, and hence dose. Metals in soil are only poorly absorbed if at all, and typically the absorbed material is retained in the epidermal layer from which it is sloughed off along with the skin. The absorption of organics is overestimated as a result of ignoring two factors: contact time and aging. The absorption of organics from soil and across skin is time dependent. There is a significant lag time in between the point of soil contact and systemic absorption of the COC(s). In fact, this lag time is generally longer than the soil remains in contact with the skin. Thus, it is likely that no significant systemic absorption occurs before the soil is removed, and the majority of what is absorbed remains trapped in the epidermis and is sloughed off with the skin before it reaches the systemic circulation.

Bioavailability of metals is an uncertainty in assessing risks due to fish tissue consumption. For surface water exposures to fish, metal bioavailability is dependent on a variety of site-specific factors, such as hardness, organic carbon, suspended solids, etc. (Bergman and Dorward-King, 1997).

Risk due to the consumption of fish tissue is due primarily to cadmium and manganese. Cadmium was detected in three of five analyses of Grand River surface water samples at concentrations ranging from approximately 0.0046 mg/L to 0.01 mg/L. Cadmium was not detected in the Kanouse Drain surface water samples. Manganese was detected in six of ten analyses of Grand River and Kanouse Drain surface water samples at concentrations ranging from 0.0033 mg/L to 0.953 mg/L. The bioaccumulation of inorganic chemicals including cadmium and manganese in fish tissue is dependent on the chemical form(s) present in surface water. Detected concentrations of inorganic chemicals in surface water samples collected from the Grand River and the Kanouse Drain are reported as total metals which measures both bioavailable and nonbioavailable forms. Therefore, because of the variety of forms of cadmium and manganese present in surface water, and their relative bioavailabilities, the estimation of fish tissue concentrations using a conservative bioconcentration factors and total metals concentrations may overestimate risk.

Uncertainty in Toxicity Assessment

A discussion of the uncertainties introduced by the toxicity values used in this assessment (*i.e.,* reference doses and slope factors) is provided below. It should be noted that several of the COCs at the site are chemicals that are either in the process of being reevaluated or will be reevaluated in the near future by U.S. EPA. COCs which will be reevaluated by the Agency include two inorganic chemicals (cadmium and chromium) and one organic chemical (vinyl chloride) evaluated in this assessment.

- *Reference Doses* - Toxicity information for many constituents is limited for humans; consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty are associated with the calculated toxicity values. U.S. EPA derives RfDs for chemicals of interest using an uncertainty factor approach. In general, the procedures used to extrapolate from animals to humans in toxicity studies include identification of a no-effect level for a sensitive parameter in a sensitive species and use of a conservative uncertainty factor (value of up to 10,000) to establish an RfD. Potential effects on humans may be overestimated rather than underestimated, since exceeding an RfD still places exposure 10-10,000 times below the level that had no effect on a sensitive animal species.

- *Route-to-Route Extrapolation* - In the Ionia risk assessment, oral toxicity values are used to fill toxicity value gaps for dermal exposures. This practice introduces uncertainties due to inherent differences in the absorption, pharmacokinetics,

and target organ specificity of chemicals following different routes of exposure. Therefore, any risk estimates calculated using these extrapolated values also carry uncertainty. Since the skin generally represents a better barrier to absorption than the gastrointestinal tract for a number of reasons, exposure via the skin would generally present less of a risk than the corresponding oral exposure. The use of oral slope factors in these scenarios represents a conservative approach to evaluating risk from dermal exposure. It should also be noted that because most toxicity data is expressed as an administered dose, oral to dermal extrapolation can subsequently underestimate risk.

- *Chemicals Lacking Toxicity Values* – The absence of quantitative information regarding the toxicity of a contaminant of interest makes it difficult to quantify risk from exposure to that chemical. In the risk assessment, several chemicals had no promulgated toxicity criteria; therefore, provisional values are used. Toxicity information from sources other than IRIS or HEAST were used to fill gaps in toxicity information. Although this practice allows for a more quantitative discussion of potential risks (rather than a purely qualitative discussion), it also adds uncertainty to the assessment.

- *Toxicity Values for Chromium* – Toxicity values for chromium (III) are used to calculate potential risks since samples were not analyzed for chromium (VI). If the chromium at the site is truly chromium (VI), potential risk estimates are underestimated.

Uncertainty in Risk Characterization

A discussion of the uncertainties introduced by how the hazards and risks were characterized in the assessment is provided below.

- *Potential for Synergistic and Antagonistic Effects* - In this assessment, the potential for noncancer and cancer health risks is evaluated assuming additivity across COCs and exposure pathways. This practice ignores possible synergisms or antagonisms which may exist between chemicals in the mixture which may affect the absorption, metabolism (metabolic activation or detoxification), and ultimately the net toxicity of the mixture. It does not take into account the possibility that there may be no interaction if the compounds have different sites of action and endpoints.

- *Compounded Uncertainties* - The risk estimates presented in this assessment result from an integration of chemical, analytical, environmental, and toxicological data that vary with regards to site-specificity. All of the uncertainties in the exposure assessment and toxicity assessment ultimately impact the risk characterization. To minimize the effects of uncertainties on the evaluation, each step is biased toward conservative (*i.e.*, protective) estimations. Because

each step builds on the previous one, risks are more likely overestimated than underestimated.

- *Summation Across Multiple Exposure Pathways* - In the risk assessment, the hazard indices and cancer risk estimates from all complete exposure pathways for a scenario are conservatively summed. For some media combinations, consistent and repeated exposures to RME conditions may over estimate risks. This may be the case for soil exposures vs. surface water and sediment exposures, as evaluated in the assessment. For example, a resident may not come into contact with surface water and sediment as frequently as with soil, thereby decreasing exposure to these media and lowering potential health risks.

Summary of Ecological Risks

Identification of Contaminants of Concern

The selection of preliminary COCs is based on analytical data collected as part of the RI/FS for the former Ionia City Landfill site. The selection process considers all chemicals detected at least once in surface water and sediment of the Grand River and the Kanouse Drain, and in surface soil collected from the former Ionia City Landfill. Chemical concentrations detected in groundwater and subsurface soil collected from the former Ionia City Landfill area are not considered, as direct exposure pathways between these media and ecological receptors are incomplete.

Surface water preliminary COCs for the Grand River and the Kanouse Drain include one organic chemical and five metals. In addition, pH is also evaluated as a preliminary COCs in surface water. Sediment preliminary COCs for the Grand River and the Kanouse Drain (non-ephemeral locations) include one organic chemical and six metals. Surface soil preliminary COCs for the former Ionia City Landfill area include two organic chemicals and eight metals.

Table 6 - Ecological Preliminary Contaminants of Concern

Media	Contaminants					
Surface Water	n-nitrosodiphen-ylamine	aluminum	cadmium	cobalt	lead	manganese
Sediment	di-n-butyl-phthalate	antimony	arsenic	barium	cadmium	lead
	manganese	silver				
Soil	di-n-butyl- phthalate		pentachlorophenol		arsenic	cadmium
	cobalt	lead	manganese	nickel	selenium	zinc

Identification of Receptors of Interest

Selection of particular wildlife species as receptors of interest (ROIs) is based on expected presence in the Ionia area based on range maps, representation of relevant trophic groups, and availability of exposure data. Bird and mammal ROIs are selected to represent maximally exposed or sensitive species in each of four feeding guilds: fish-eaters (piscivores), aquatic invertebrate-eaters (invertivores), terrestrial invertivores; and terrestrial plant-eaters (herbivores).

Wildlife ROIs selected to characterize exposures received from the site include the belted kingfisher (*Ceryle alcyon*) and mink (*Mustela vison*) as piscivores, the spotted sandpiper (*Actitis macularia*) and raccoon (*Procyon lotor*) as aquatic invertivores, the northern bobwhite (*Colinus virginianus*) and the meadow vole (*Microtus pennsylvanicus*) as terrestrial herbivores, and the American woodcock (*Scolopax minor*) and the short-tailed shrew (*Blarina brevicauda*) as terrestrial invertivores. Exposure information is readily available for each of these species.

It is important to note that wildlife species other than those identified above may be more commonly encountered at the former Ionia Landfill area of concern. However, wildlife ROIs are selected to represent potentially sensitive taxonomic classes and feeding guilds according to selection criteria specified in U.S. EPA guidance (1989, 1992, 1994, 1995a, 1996a, 1997a, 1998). For example, the northern bobwhite and the American woodcock have extensive contact with soil, making them excellent representatives of other more common herbivorous and invertivorous bird species. Terrestrial predators that feed on herbivorous or invertivorous species are not assessed due to the extreme uncertainty of modeling chemical uptake through several trophic levels of the food web. The wildlife receptors selected for the risk assessment are described as below.

- **Belted kingfisher:** The belted kingfisher represents piscivorous birds. This species feeds primarily on fish, which it captures by diving into the water.

- **Mink:** The mink represents piscivorous mammals. The mink is a top-level carnivore that feeds almost exclusively on fish, small mammals, birds, eggs, frogs, and macroinvertebrates. Mink have been shown to have a heightened sensitivity to some chemicals (Bleavins *et al.*, 1984; Rush *et al.*, 1983).

- **Spotted sandpiper:** The spotted sandpiper represents aquatic invertivorous birds, such as shorebirds and waterfowl. This species is expected to feed on sediment organisms and have extensive contact with sediment. The spotted sandpiper has a relatively small home range and body size and, for these reasons is expected to experience greater exposure to chemicals than larger invertivorous birds.

- **Raccoon:** The raccoon represents aquatic invertivorous mammals. In general, mammals do not feed exclusively on aquatic and benthic invertebrates. However, it is possible that the raccoon could feed primarily on invertebrates (U.S. EPA,1993a), and an exclusively invertivorous diet is conservatively assumed.

- **Northern bobwhite:** This species of quail represents terrestrial herbivorous birds. The northern bobwhite has a relatively small home range and predominantly consumes plants. Additionally, the northern bobwhite is expected to have extensive contact with soil.

- **Meadow vole:** The meadow vole represents terrestrial herbivorous mammals. This species has a small home range and a smaller body weight than most herbivorous mammals that might be present at the site, and it is therefore expected to experience higher exposure levels than other herbivores.

- **American woodcock:** The American woodcock represents terrestrial invertivorous birds. The American woodcock is expected to feed on soil organisms and have extensive contact with soil.

- **Short-tailed shrew:** The short-tailed shrew represents terrestrial invertivorous mammals. It is assumed to be common in suitable habitats at the site and to have a small home range. The short-tailed shrew is expected to experience a greater exposure to chemicals than larger invertivorous mammals, because shrews must consume large amounts of prey to sustain their high metabolic rates.

Aquatic receptors are identified for the Grand River and the Kanouse Drain. Aquatic receptors selected for the assessment include fish and aquatic invertebrates (water column-dwelling), and benthic invertebrates (sediment-dwelling).

- **Fish and Aquatic Invertebrates:** Fish and aquatic invertebrates live in the water column and are directly exposed to the highest concentrations of chemicals in water. Fish and aquatic invertebrates serve as primary and secondary consumers and as prey species for higher-trophic-level organisms.

- **Benthic Invertebrates:** Benthic invertebrates live in sediment and feed on detritus or other organisms in the sediment. As such, they are directly exposed to the highest concentrations of chemicals in sediment. Benthic invertebrates are significant primary consumers in many freshwater systems and are prey species for some species of resident fish, amphibians, birds, and mammals. Benthic invertebrates are evaluated in the Grand River and Kanouse Drain (non-ephemeral locations only).

Rare, Endangered and Threatened Species

The MDEQ contacted the MDNR Natural Heritage Program to determine the presence of threatened or endangered species or other natural features at or near the former Ionia City Landfill site. The Endangered Species Program responded that the project "will not affect any known threatened or endangered species or other natural features". Based on this, there are no known rare, endangered or threatened species at or near the site.

Exposure Assessment

Exposure assessment endpoints are explicit statements of the characteristics of the ecological system that are to be protected. Endpoints are either measured directly or are evaluated through indirect measures. Measurement endpoints represent quantifiable ecological characteristics that can be measured, interpreted, and related to the valued ecological components chosen as the assessment endpoints. The following assessment and measurement endpoints are used to interpret ecological risks for the site:

Assessment Endpoint #1: Survival and maintenance of fish and aquatic invertebrate community structure and function.

Measurement Endpoint: Comparison of preliminary COC concentrations in surface water with concentrations associated (in field and laboratory studies) with adverse effects to growth, reproduction, or survival of aquatic organisms.

Assessment Endpoint #2: Survival and maintenance of benthic invertebrate community structure and function.

Measurement Endpoint: Comparison of preliminary COC concentrations in sediment with concentrations associated (in field and laboratory studies) with adverse effects to growth, reproduction, or survival of benthic invertebrates.

Assessment Endpoint #3: Survival of terrestrial plant and invertebrate communities.

Measurement Endpoint: Comparison of preliminary COC concentrations in surface soil to concentrations representing adverse effects to survival of plants, earthworms, or soil microorganisms and ecological processes, based on laboratory studies described in the scientific literature.

Assessment Endpoint #4: Survival of wildlife populations and communities.

Measurement Endpoint: Comparison of exposure concentrations of preliminary COCs in ingested media and food with concentrations associated with adverse effects to growth, reproduction, or survival of laboratory animals (birds and mammals).

A site conceptual model showing the potential ecological exposure pathways can be seen in Figure 3.

Effects Characterization

The effects characterization is a qualitative and quantitative description of the relationship between the concentration of a preliminary COC in surface water, sediment, or surface soil, and the nature of possible effects elicited in exposed receptors, populations, and/or ecological communities. An effects characterization is completed separately for the ROIs. The results of this effects characterization and the exposure characterization are combined to characterize the risks to ROIs posed by preliminary COCs of the former Ionia City Landfill area of interest.

Fish and Aquatic Invertebrates

The effects characterization for fish and aquatic invertebrates includes six preliminary COCs: one organic chemical (*n*-nitrosodiphenylamine); and five metals (aluminum, cadmium, cobalt, lead, and manganese). For the ecological risk assessment, these preliminary COCs are assessed based on comparisons of site data to screening benchmarks and published numerical water quality standards and criteria, and screening benchmarks. These include Michigan Water Quality Criteria (MWQC) and other values. State-mandated water-quality criteria (MWQC) generally supersede federal Ambient Water Quality Criteria (AWQCs) for all state waterways. Acute and chronic criteria are used to evaluate direct toxicity from short- and long-term exposures, respectively, although they do not correspond to specific levels or types of adverse effects for any particular organism. Adverse effects on exposed aquatic biota may occur if either acute or chronic benchmarks are exceeded. There is little likelihood that exposure concentrations lower than chronic benchmarks pose a hazard to exposed organisms.

Michigan Water Quality Criteria (MWQC). Two types of MWQC are available (MDEQ, 1998). The "chronic aquatic criterion" (CAC) is the maximum concentration of a chemical at which no chronic effects occur to aquatic organisms exposed for periods averaging 30 days. The "acute aquatic criterion" (AAC) is the maximum concentration at which no acute effects occur to aquatic organisms exposed for brief (unspecified) periods. Criteria of these types are

intended to protect, with reasonable confidence, most aquatic species most of the time.

National Ambient Water Quality Criteria (AWQC). The AWQC consist of (1) the "continuous chronic criterion" which is the maximum concentration of a chemical at which no chronic effects occur to aquatic organisms exposed for at least a four day period; and (2) the "criteria maximum concentration" which is the maximum concentration at which no acute effects occur to aquatic organisms exposed for an average of one hour.

Tier II secondary acute (SAV) and chronic (SCV) values. Alternative toxicity-based screening benchmarks used for chemicals without MWQC or AWQC include Tier II secondary acute (SAV) and chronic (SCV) values for fish and invertebrates. Tier II SAV and SCV values are developed when only limited toxicity data are available for a chemical, using a set of uncertainty factors that depend on the amount and type of data available. Tier II values are estimated from 48-96 hour acute toxicity tests, to include at least one daphnid study (Final Water Quality Guidance for the Great Lakes System; Final Rule, 60CFR15366, 3/23/95). Alternative methods described by Suter and Tsao (1996), which include additional safety factors, can be used when daphnid studies are lacking (U.S. EPA, 1996b). The SAVs and SCVs are generally more conservative screening benchmarks than the AWQC.

Detected concentrations of surface water preliminary COIs in the Grand River and Kanouse Drain are compared to "chronic aquatic criteria", which are the maximum concentrations of chemicals at which no chronic effects occur to aquatic organisms and "acute aquatic criteria", which are the maximum concentrations at which no acute effects occur to aquatic organisms exposed for brief periods.

Benthic Invertebrates

Only a small number of chemicals are selected as COCs in sediment based on preliminary exceedance of EDQLs. These include one organic chemical (di-n-butyl phthalate), and seven metals (antimony, arsenic, barium, cadmium, lead, manganese, and silver). See Ecological Risk Table 3.

Soil Flora and Fauna Benchmarks (Plants, Invertebrates, Microbes)

For the ecological risk assessment, the potential for adverse effects on soil flora and fauna is characterized for eleven soil preliminary COCs: two organic chemicals (di-n-butyl phthalate and pentachlorophenol); and nine metals (arsenic, cadmium, cobalt, copper, lead, manganese, nickel, selenium, and zinc). Screening-level benchmarks for

surface soils have been developed for protection of plants, earthworms, and soil microbes (Efroymson *et al.*, 1997a, 1997b).

Wildlife

For the ecological risk assessment, the effects characterization for wildlife receptors includes the derivation of receptor-specific toxicity reference values (TRVs) from available toxicological data, and development of sediment and soil screening benchmarks calculated from a simplified food web model.

Risk Characterization

Risk characterization is conducted in two steps. First, preliminary COC concentrations or doses are compared to conservative benchmark values. Then, for preliminary COCs with concentrations exceeding conservative benchmark values, a weight-of-evidence approach is used to evaluate the potential significance of the exceedances.

Fish and Aquatic Invertebrates

Potential risks to fish and aquatic invertebrates in the Grand River and the Kanouse Drain are assessed for all life stages based on the evaluation of preliminary COC concentrations in surface water. The following surface water preliminary COCs are assessed: n-nitrosodiphenylamine, aluminum, cadmium, cobalt, lead, manganese, and pH. All detected concentrations of preliminary COCs are compared with the water quality standards. This type of comparison is conservative because the average concentration of each preliminary COC is the best approximation of conditions to which aquatic organisms are chronically exposed, whereas the maximum concentration is expected to represent localized or ephemeral conditions which mobile aquatic organisms would encounter only as acute exposures. See Ecological Risk Table 1.

Benthic Invertebrates

The risk characterization for benthic invertebrates in the Grand River and Kanouse Drain (non-ephemeral locations) is based on the comparison of concentrations of preliminary COCs in sediments with the sediment quality benchmarks. Di-n-butyl phthalate is assessed using the equilibrium partitioning approach and the maximum detected concentration of di-n-butyl phthalate in sediment. The potential for effects of inorganic chemicals on benthic invertebrates is assessed based on three sets of published benchmarks, which are interpreted using a weight-of-evidence approach. See Ecological Risk Table 2.

Soil Flora and Fauna (Surface Soil)

The risk characterization for soil flora and fauna in the former Ionia City Landfill area (including sediment samples collected from ephemeral locations of the Kanouse Drain) is based on the comparison of arithmetic mean and maximum concentrations of preliminary COCs in surface soil with the soil quality benchmarks. The soil quality benchmarks are based on observations of toxicity to plants, earthworms, and soil microbes.

Several lines of evidence may be used to evaluate the potential for adverse effects on soil flora and fauna due to preliminary COCs for which measured concentrations exceed screening-level soil quality benchmarks. These include site-specific and regional background concentrations, the magnitude of exceedance of the soil quality benchmarks, and the confidence level assigned to the benchmarks. Additionally, Efroymson *et al.* (1997a) indicate that the presence of a "vigorous and diverse" plant community can be taken as evidence of a lack of phytotoxicity, even if soil benchmarks for plants are exceeded.

Risks to soil flora and fauna are assessed for di-n-butyl phthalate, pentachlorophenol, arsenic, cadmium, cobalt, lead, manganese, nickel, selenium, and zinc. Based on comparison to benchmarks, ecological effects are unlikely from exposures of soil flora and fauna to di-n-butyl phthalate, pentachlorophenol, cadmium, cobalt, and nickel. The potential for soil toxicity due to the remaining preliminary COCs (arsenic, lead, manganese, selenium, and zinc) is examined using a weight-of-evidence approach, as discussed below. See Ecological Risk Table 3.

Wildlife

The risk characterization for wildlife ROIs includes risk estimation, based on the comparison of estimated exposures for surface water preliminary COCs to toxicological benchmarks, and the comparison of arithmetic mean and maximum detected concentrations of preliminary COCs in sediments and soil with the site-specific screening-level benchmarks. Wildlife screening benchmarks are developed for bird and mammal ROIs representing four feeding guilds: piscivores, aquatic invertivores, terrestrial invertivores, and terrestrial herbivores.

Risk estimates for wildlife receptors exposed to preliminary COCs at the former Ionia City Landfill site are expressed as Hazard Quotients (HQs). For surface water preliminary COCs (See Ecological Risk Tables 4 and 6), HQs are defined as the ratio between the estimated ADD and the ROI-specific TRV. The HQs for sediment (See Ecological Risk Table 5) and soil (See Ecological Risk Table 7) preliminary COCs are defined as the ratio between the sediment or soil EPC and the risk-based wildlife screening-level benchmark values. All HQs are calculated for each preliminary COC based on available NOAEL and LOAEL TRVs or NOAEL- and LOAEL-based screening-level benchmarks.

For sediment and soil preliminary COCs, if all exposure assumptions are met, and (1) the sediment or soil arithmetic mean concentration is less than the NOAEL benchmark, and (2) the maximum detected concentration is less than the LOAEL benchmark, then risk to wildlife receptors due to the preliminary COC is unlikely, because the average estimate of exposure does not exceed a highly protective estimate of a "safe" (no-adverse-effect) concentration, and maximum estimate of exposure does not exceed the lowest effects level. When the arithmetic mean concentration is equal to or exceeds the NOAEL benchmark but the maximum detected concentration does not exceed the LOAEL benchmark (or a LOAEL benchmark cannot be calculated due to lack of a LOAEL TRV), the estimated risk to wildlife receptors is indeterminate, because the exposure concentration at which effects become apparent is not known. An average estimate of exposure (*i.e.*, the mean concentration) greater than or equal to the LOAEL benchmark indicates that adverse ecological effects to wildlife receptors are possible.

It is important to note that HQs exceeding 1.0, cannot be used to quantify the magnitude of potential effects because the benchmarks are point-estimates based on effect and no-effect exposure concentrations. The magnitude of an adverse effect for each receptor is constrained by the assumptions of the exposure characterization and can only be characterized if the dose–response function is known (*i.e.*, a well-characterized range of exposures associated with a well-defined range of effects). Nonetheless, point estimate benchmarks do provide an indication of the potential for ecological risks in a screening-level assessment.

No COCs are identified for wildlife receptors at the former Ionia City Landfill site, based on the comparison of estimated doses or measured preliminary COC concentrations with screening-level benchmarks and additional weight of evidence for specific chemicals. The comparison to screening benchmarks is summarized for the Grand River and Kanouse Drain area (non-ephemeral locations), and the former Ionia City Landfill area (including sediment samples collected from ephemeral locations of the Kanouse Drain) as follows:

Grand River and Kanouse Drain

Surface Water: Under the assumptions of the exposure and effects characterizations for the Grand River and Kanouse Drain, ecological effects on aquatic-feeding wildlife are unlikely from exposures of all receptors to preliminary COCs in surface water (See Ecological Risk Table 4).

Sediment: Under the assumptions of the exposure and effects characterizations for the former Ionia City Landfill site, adverse effects on aquatic-feeding wildlife due to preliminary COC concentrations in sediment are:

- unlikely from exposures of all receptors to di-n-butyl phthalate, barium, cadmium, lead, manganese, and silver; and

- indeterminate for exposures of raccoon (aquatic invertivorous mammal) to antimony and indeterminate for exposures of raccoon to arsenic.

It is important to point out that the NOAEL HQ is approximately 1 for mink (aquatic piscivorous mammal) due to antimony concentrations in sediment. Therefore, effects on the mink and raccoon due to antimony concentrations in sediment are evaluated further. Maximum detected concentrations of sediment preliminary COCs were compared to NOAEL-based benchmarks to prevent preliminary COCs from being inappropriately eliminated from the screening process. Based on the comparison of maximum detected concentrations of sediment preliminary COCs to NOAEL-based benchmark values, no additional preliminary COCs were selected for further evaluation.

Former Ionia City Landfill Area

Surface Water: Under the assumptions of the exposure and effects characterizations for the former Ionia City Landfill area, adverse effects on terrestrial-feeding wildlife due to preliminary COC concentrations in surface water are:

- unlikely from exposures of all ROIs to N-nitrosodiphenylamine, aluminum, cobalt, lead, and manganese; and

- indeterminate for exposures of American woodcock (terrestrial invertivorous bird) to cadmium.

The estimated total average daily dose for cadmium slightly exceeds the cadmium TRV resulting in a HQ of approximately 1 (See Ecological Risk Table 6). However, the total average daily dose for the American woodcock incorporates exposure concentrations of cadmium in surface water, and soil and prey (terrestrial invertebrates). The contribution of cadmium in surface water to the estimated total potential dose received by the woodcock is less than 0.23 percent. Thus, the relative contribution of cadmium in surface water is insignificant (< 1%). However, cadmium was further examined using site-specific soil screening-level benchmarks.

Soil: Under the assumptions of the exposure and effects characterizations for the former Ionia City Landfill area, adverse effects on terrestrial-feeding wildlife due to preliminary COC concentrations in surface soils are:

- unlikely from exposures of all ROIs to di-n-butyl phthalate, pentachlorophenol, cobalt, manganese, nickel, and selenium; and

- indeterminate for exposures of short-tailed shrew (terrestrial invertivorous mammal) to arsenic, and indeterminate for exposures of American woodcock (terrestrial invertivorous bird) to zinc.

It is important to point out that for the American woodcock, the NOAEL HQ for cadmium, and LOAEL HQ for lead are approximately 1 (soil concentration is approximately equal to the benchmark concentration). Therefore, effects on the American woodcock due to cadmium and lead concentrations in soil are also discussed. Maximum detected concentration of soil preliminary COCs were compared to NOAEL-based benchmarks to prevent preliminary COCs from being inappropriately eliminated from the screening process. Based on the comparison of maximum detected concentration of soil preliminary COCs to NOAEL-based benchmarks, only one additional preliminary COC (selenium) is identified as being possibly indeterminate for the American woodcock and the short-tailed shrew. Therefore, adverse effects on terrestrial-feeding wildlife due to selenium concentrations in surface soils are further evaluated for the American woodcock and the short-tailed shrew.

The chemicals for which ecological effects are initially estimated to be indeterminate (antimony, arsenic, cadmium, lead, selenium, and zinc) are examined for all aquatic and terrestrial areas of interest using a weight-of-evidence approach to identify chemicals and study areas that merit further attention with regard to risk management decision-making. Sediment and soil concentrations are compared to background levels as part of the weight of evidence. Based on a weight of evidence approach, antimony, arsenic, cadmium, lead, and zinc are unlikely to adversely affect wildlife receptors.

Uncertainty Analysis

In general, the ecological risk assessment is intended to provide a conservative risk evaluation that is protective of the most sensitive species in the study area of interest. Sources of uncertainty in the assessment may result in overestimation or underestimation of risks. The primary sources of uncertainty in the SERA are related to preliminary COC selection, conceptual site model assumptions, surface water exposure assessment, bioavailability of organic chemicals and metals, chemicals having limited toxicological information, and wildlife screening benchmark derivation.

Preliminary COC Selection

The preliminary COC selection process is intended to be conservative and should generally prevent detected chemicals from being inappropriately eliminated as COCs.

Several inorganic chemicals were eliminated as preliminary COCs based on comparisons to naturally occurring site-specific and regional background concentrations. The comparison to background concentrations presented in the assessment is consistent with U.S. EPA guidance. Further, reported site-specific background concentrations are similar to reported regional concentrations confirming that this approach is appropriate for risk assessment.

Conceptual Site Model

Screening benchmarks for assessing risks to fish and aquatic invertebrates due to chemical concentrations in sediment are not available. However, it is expected that any chemical analytes that pose a significant risk to fish would be identified based on the assessment of benthic invertebrates and wildlife. Since no risks to benthic invertebrates or aquatic-feeding wildlife are identified in the assessment, it is unlikely that preliminary COCs in sediment have the potential to adversely affect aquatic invertebrates or fish.

Surface Water Exposure Assessment

Surface water samples collected as part of the RI/FS were obtained during two sampling events. However, factors such as storm-water runoff or seasonal variation may cause temporal variation in surface water chemistry. This represents a source of uncertainty in the assessment of analytical results obtained from the two surface water sampling events.

For the assessment, fish and aquatic invertebrates are assumed to be potentially exposed to preliminary COCs in surface water collected from the Kanouse Drain and the Grand River subareas. In general, the potential for the drainage ditch to support large fish and aquatic invertebrate communities is limited by several physical characteristics including:

- ephemeral conditions;
- presence of highly modified bed and banks with little or no physical structure;
- presence of unstable, homogenous substrate of poor quality; and
- frequent scouring during periods of heavy precipitation, resulting in the removal of essential nutrients.

Bioavailability of Organic Chemicals

For hydrophobic organic chemicals, sediment or soil organic carbon content should be used to assess site-specific bioavailability. There are no measurements of TOC concentrations in sediment or surface soil from the former Ionia City Landfill site; thus, sediment and surface soil were conservatively assumed to contain 1% TOC for the assessment of benthic invertebrates and wildlife receptors. Additionally, the U.S. EPA estimates that a four to five-fold variation can be expected between observed sediment effects thresholds and those predicted based on equilibrium partitioning for hydrophobic organic chemicals. Others have suggested that the equilibrium partitioning approach may produce benchmarks that are overly conservative by several orders of magnitude in some cases, due to the slow rate of desorption from sediment particles for persistent contaminants (Kan *et al.*, 1998).

Bioavailability of Metals

Bioavailability of metals is an uncertainty in assessing risks to all receptor groups. For surface water exposures (fish and aquatic invertebrates), metal bioavailability is dependent on a variety of site-specific factors, such as hardness, organic carbon, suspended solids, etc. The water quality standards used in the assessment are designed to be conservative, and it is possible that the bioavailability of metals is further limited by site-specific factors. Site-specific data for hardness are used to calculate water quality criteria for some metals, but were not available for the assessment. However, hardness data for surface water collected from upstream locations in the Grand River are available (MDEQ, 1999). Therefore, based on data collected by the MDEQ (1999), an average hardness value of 260 mg/L as $CaCO_3$ was used to calculate water quality criteria for lead and cadmium.

For the assessment of benthic invertebrates, the toxicity of metals is particularly uncertain, as site-specific factors affecting bioavailability are less understood. Methods recently developed for assessing whether sulfide concentrations preclude metal bioavailability require specialized analyses, which have not been conducted at the former Ionia City Landfill site. For soil flora and fauna, the risk characterization is also based on standard U.S. EPA extraction techniques designed to measure total chemical concentrations, as opposed to measurements of the potentially bioavailable fraction. While effects benchmarks for soil are derived using the same type of extraction, the benchmarks are conservative and therefore are likely to reflect soil conditions that promote a high level of contaminant bioavailability.

For wildlife, assumptions regarding the concentrations of metals in prey and the bioavailability of metals in all ingested media strongly influence risk estimation. The use of conservative uptake factors is necessary for plants, invertebrates and forage fish, because preliminary COC concentrations in prey tissue have not been directly measured. For many metals, the default uptake assumptions may overestimate exposures to wildlife.

Chemicals with Limited Toxicological Information

Toxicological data for manganese is insufficient to support state or federal water quality criteria, and alternative Tier II methodology is used in the effects assessment for the assessment. Tier II values are developed using a set of conservative uncertainty factors that range from 3.6 to 242, depending on the amount and type of data available. The use of limited data could result in either overestimation or underestimation of risks to sensitive aquatic species; however, Tier II values are generally more conservative than federal water quality criteria.

Appropriate toxicological information used to estimate TRVs, and screening benchmark values for bird receptors are lacking for n-nitrosodiphenylamine, antimony, cobalt, and silver. However, TRVs and screening benchmark values for mammals are estimated

for all surface water, sediment and soil preliminary COCs. The lack of appropriate toxicological information for bird receptors may result in underestimation of risks to sensitive avian species; however, the evaluation of toxicological information for mammals, and the conservatisms inherent in the derivation of TRVs and screening benchmark values for mammals reduces the potential for underestimation of potential risks to bird receptors due to a lack of toxicity data for these receptors.

Wildlife Screening Benchmarks

The food web-based model used to develop screening benchmarks for wildlife requires a number of assumptions, which could result in either overestimation or underestimation of risks to the receptors. For example, ROI body weights and ingestion rates are estimated from limited information. The estimation of organic preliminary COC concentrations in prey items is also uncertain, although it is generally based on applicable scientific literature. An important conservative assumption is that each receptor forages entirely within the former Ionia City Landfill area of interest. The foraging area of birds and mammals is a function of habitat suitability and productivity, as well as species-specific foraging behavior, and the spatial extent of foraging at the former Ionia City Landfill site was not evaluated for this assessment. In addition, the receptors are assumed to feed entirely on specified food sources, although some animals, like raccoons, may feed opportunistically on a variety of food types. The NOAEL and LOAEL TRVs identified for wildlife receptors represent the most conservative of applicable toxicity test results identified from the literature. Uncertainty factors are used, when needed, to provide TRVs that are representative of chronic exposure and sub-lethal effects. This approach may overestimate the sensitivity of many ecological receptors.

An aspect of the effects assessment that may contribute to either overestimation or underestimation of risk is the lack of appropriate toxicological information for characterizing effects of several individual chemicals and of mixtures of preliminary COCs. Chemicals may act in an additive, antagonistic, or synergistic manner when ingested by wildlife in a complex mixture. Within chemical classes, effects are believed to be additive; however, the extent to which different types of chemicals interact to affect toxicity is not known.

H. REMEDIATION OBJECTIVES

The remediation objectives are:

1. To protect human health and the environment from exposure to contaminants from the site that exceed acceptable risk levels, both for current and future exposure scenarios, and ;

2. To reduce or eliminate potential sources to the Grand River and Kanouse Drain.

These remediation objectives will be achieved by

- Collecting and treating contaminated groundwater to contain the 500 ug/L total VOC contaminant plume and reducing further migration from the source area,

- Reducing cross media migration of contaminants from groundwater to surface water, and

- Monitoring of natural processes to reduce contaminated groundwater outside the influence of the pump and treat system capturing the 500 ug/L total VOC contaminated plume.

I. DESCRIPTION OF ALTERNATIVES

General response actions are media-specific actions which fulfill site-specific remedial objectives. Four general response action categories were developed for addressing environmental conditions at the Ionia City Landfill site. The categories of general response actions to be considered for contaminated media at the site include:

- **No Further Action** - This action category serves as a basis against which other remedial actions are compared against and may be selected where current and future risks are within acceptable ranges.

- **Institutional Controls** - This action category includes administrative controls to place restrictions on site development and actions to restrict access to the site.

- **Containment** - This action category includes alternatives that provide for the isolation or containment of waste with little to no treatment.

- **Treatment** - This action category includes active restoration approaches eliminate or greatly reduce risks posed by site contaminants or minimize the need for long-term management.

Based on RI/FS reports and previous investigations, U.S. EPA evaluated several alternatives to address groundwater contamination at the Ionia City Landfill. In evaluating the alternatives, U.S. EPA considered the level of protection that would satisfy the concern of the natural resource trustees to the extent to which implementing the alternatives could bring about additional adverse impacts to natural resources.

Groundwater Alternatives

Groundwater Alternative 1: No Further Action

Estimated Capital Cost: $0
Annual O & M Cost: $0
Total Present Value (7% discount rate): $0
Estimated Time to Implement: N/A

The NCP requires that a No Action alternative be incorporated into the evaluation and selection of a remedial action for an NPL site. This option represents the no action option for management of groundwater at the Ionia City Landfill. The alternative serves as a baseline against which all groundwater alternatives can be compared/contrasted. If current and future risk support a no action alternative, this option could be selected. This alternative would provide for no long-term monitoring or institutional controls.

Groundwater Alternative 2: Institutional Controls and Long-term Monitoring

Estimated Capital Cost: $23,800
Annual O & M Cost: $40,500
Duration of O & M: 30 years
Total Present Value (7% discount rate): $526,400
Estimated Time to Implement: Immediate

Under this alternative, institutional controls would be implemented to restrict exposure to potential hazards at a site. In the case of the Ionia City Landfill site, the City of Ionia (owner of the property) would place restrictions on development of the property (deed restrictions), prohibit construction of drinking water or irrigation wells and provide monitoring and maintenance of the site. Under this alternative, monitoring of the groundwater would be accomplished using an existing array of on-site wells. Monitoring would allow contamination migration and contaminant attenuation to be tracked and remedial action to be taken if necessary.

Groundwater Alternative 3: Monitored Natural Attenuation

Estimated Capital Cost: $80,000
Annual O & M Cost: $46,100
Duration of O & M: 30 years
Total Present Value (7% discount rate): $652,000
Estimated Time to Implement: Immediate

Under this alternative, monitored natural attenuation would be tracked. Monitored natural attenuation is an in-situ process that relies on a number of natural processes to reduce the mass, toxicity, mobility, volume or concentration of contaminants in groundwater. These processes include biodegradation, chemical transformations, volatilization, dilution, dispersion, and adsorption. The ability of natural attenuation to be an effective remedial method

depends on a variety of conditions including soil type, availability of nutrients, temperature, concentration of contaminants etc. Monitored natural attenuation is "the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site clean-up approach) to achieve site-specific rededication objectives within a time frame that is reasonable compared to that offered by other more active methods". There is evidence that natural attenuation is occurring at the Ionia City Landfill site. The presence of the biotransformation products cis-1,2-dichloroethene and vinyl chloride within the plume is indicative of biologically mediated, reductive dechlorination. Monitored natural attenuation is typically used in conjunction with another active rededication measure. Natural attenuation monitoring would be conducted until federal and state regulatory limits are obtained throughout the A-1 aquifer.

Groundwater Alternative 4: Groundwater Extraction Without Treatment, Discharge to Surface Water, and Long-term Monitoring

Estimated Capital Cost: $2,800
Annual O & M Cost: $102,100
Duration of O & M: 30 years
Total Present Value (7% discount rate): $1.3 million.
Estimated Time to Implement: 4 months

Under this alternative, the A-1 aquifer would be hydraulically controlled immediately downgradient of the former point source area to reduce the potential for future downgradient impacts. This action would minimize the potential for exposure from use of the groundwater. Without treatment, this alternative would essentially remove the contaminants from the groundwater and transfer them directly to a surface water body. Operation and maintenance of the existing extraction and treatment system that captures the 500 ug/L total VOC contaminant plume would continue. In addition, monitored natural attenuation of the groundwater outside of the 500 ug/L contaminant plume would be conducted until it could be demonstrated that, through natural processes alone in the groundwater outside of the isoplath, MCLs would be achieved and not exceeded at the waste boundary over time and that GSI discharge limits would be achieved and not exceeded in waters of the state over time. At this site, the waste boundary is considered the property boundary.

Groundwater Alternative 5: Groundwater Extraction Without Treatment, Discharge to POTW, and Long-term Monitoring

Estimated Capital Cost: $0
Annual O & M Cost: $102,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $1.3 million.
Estimated Time to Implement: Immediate

Under this alternative, the A-1 aquifer would be hydraulically controlled immediately downgradient of the former point source area to reduce the potential for

future downgradient impacts. However, collected groundwater would be discharged to the POTW without treatment. This alternative may require temporary on-site storage to allow for testing of extracted groundwater prior to discharge to the POTW. Operation and maintenance of the existing extraction and treatment system that captures the 500 ug/L total VOC contaminant plume would continue. In addition, monitored natural attenuation of the groundwater outside of the 500 ug/L contaminant plume would be conducted until it could be demonstrated that, through natural processes alone in the groundwater outside of the isoplath, MCLs would be achieved and not exceeded at the waste boundary over time and that GSI discharge limits would be achieved and not exceeded in waters of the state over time. At this site, the waste boundary is considered the property boundary.

Groundwater Alternative 6: Groundwater Extraction, Air Stripping, Discharge to POTW and Long-term Monitoring

Estimated Capital Cost: $0
Annual O & M Cost: $107,600
Duration of O & M: 30 years
Total Present Value (7% discount rate): $1.3 million.
Estimated Time to Implement: Immediate

Under this alternative, groundwater would continue to be collected and volatile organics would be removed using the existing air stripper. Typically, the groundwater stream is introduced at the top of the tower while air is blown into the base of the tower and flows upward, contacting the water. Volatile chemicals are transferred from the groundwater to the air via continuous contact in the tower. If necessary, polishing of the resultant liquid stream utilizing liquid phase carbon adsorption can be included as well as treatment of the air stream by vapor phase carbon adsorption or catalatic oxidation. Filters and holding tanks and auxiliary pumps would also be required. The system can be modified/enhanced if additional recovery wells are required to contain the plume. Treated groundwater can be discharged to the POTW. Operation and maintenance of the existing extraction and treatment system that captures the 500 ug/L total VOC contaminant plume would continue. In addition, monitored natural attenuation of the groundwater outside of the 500 ug/L contaminant plume would be conducted until it could be demonstrated that, through natural processes alone in the groundwater outside of the isoplath, MCLs would be achieved and not exceeded at the waste boundary over time and that GSI discharge limits would be achieved and not exceeded in waters of the state over time. At this site, the waste boundary is considered the property boundary.

Groundwater Alternative 7: Groundwater Extraction, Carbon Adsorption, Discharge to POTW, and Long-term Monitoring

Estimated Capital Cost: $2,600
Annual O & M Cost: $111,500
Duration of O & M: 30 years
Total Present Value (7% discount rate): $1.4 million.
Estimated Time to Implement: 4 months

Under this alternative, the existing air stripper unit would be removed from the existing system and a carbon adsorption unit would be installed. Volatile organic constituents in groundwater at the site are amenable to adsorption on activated carbon. This alternative would employ, at a minimum, a two cell unit with the units connected in series. Effluent quality would be monitored following the primary unit. Once breakthrough of the contaminants from the primary unit occurred, the primary cell would be taken off-line and removed, with the secondary cell becoming the new primary unit. A new cell would be added in the treatment train and become the secondary or polishing cell. Utilizing this design, the maximum absorptive capacity of the carbon would be exploited. The saturated carbon units can be regenerated or disposed. Treated groundwater would be discharged to the POTW. Operation and maintenance of the existing extraction and treatment system that captures the 500 ug/L total VOC contaminant plume will continue. In addition, monitored natural attenuation of the groundwater outside of the 500 ug/L contaminant plume would be conducted until it could be demonstrated that, through natural processes alone in the groundwater outside of the isoplath, MCLs would be achieved and not exceeded at the waste boundary over time and that GSI discharge limits would be achieved and not exceeded in waters of the state over time. At this site, the waste boundary is considered the property boundary.

J. COMPARATIVE ANALYSIS OF ALTERNATIVES

The nine criteria used by U.S. EPA to evaluate remedial alternatives, as set forth in the NCP, 40 C.F.R. Part 300.430, include: 1) overall protection of human health and the environment; 2) compliance with applicable or relevant and appropriate requirements (ARARs); 3) long-term effectiveness and permanence; 4) reduction of toxicity, mobility, or volume through treatment; 5) short-term effectiveness; 6) implementability; 7) cost; 8) state acceptance; and, 9) community acceptance.

The first two evaluation criteria are threshold criteria that all alternatives must meet. Criteria 3 through 7 are balancing criteria that are used to compare the alternatives against each other and determine which alternative provides the best balance of the evaluation criteria. The remaining two criteria are modifying criteria. The input from the community and the support agency are considered by the lead agency in making its final decision.

Threshold Criteria

1. **Overall Protection of Human Health and the Environment** addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced or controlled through treatment, engineering, or institutional controls. The selected remedy must meet these criteria.

2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** addresses whether a remedy will meet applicable or relevant and appropriate federal and state environmental laws and/or justifies a waiver from such requirements. The selected remedy must meet this criterion or a waiver of the ARAR must be attained.

Primary Balancing Criteria

3. **Long-Term Effectiveness and Permanence** refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met.

4. **Reduction of Toxicity, Mobility, or Volume Through Treatment** addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

5. **Short-Term Effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the time period until cleanup levels are achieved.

6. **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital costs, annual operation and maintenance costs (assuming a 30-year time period), and net present value of capital and operation and maintenance costs.

Modifying Criteria

8. **State Acceptance** considers whether the state agrees with U.S. EPA's analyses and recommendations of the RI/FS and the Proposed Plan, and considers state ARARs.

9. **Community Acceptance** addresses the public's general response to the remedial alternatives and proposed plan. The ROD will include a responsiveness summary that presents public comments and U.S. EPA responses to those comments. Acceptance of the recommended alternative will be evaluated after the public comment period.

Consistent with the rest of this document, the comparative analysis of the nine criteria will be organized by river component and presented in a tabular format.

Ground-water Comparative Analysis

Nine Criteria	Alt. 1 No Action	Alt. 2 Institutional Controls	Alt. 3 Monitored Natural Attenuation	Alt. 4 Extraction Without Treatment and Discharge to Surface Water	Alt. 5 Extraction Without Treatment and Discharge to POTW	Alt. 6 Extraction, Air Stripper and Discharge to POTW	Alt. 7 Extraction, Liquid-Phase Carbon Absorption and Discharge to POTW
Overall Protection of Human Health and the Environment	Exposure to the shallow ground-water at the site presents an unaccept-able risk. The City of Ionia and Michigan Dept. of Public Health preclude installation of a drinking water well at or near the site. There is no risk reduction under this alternative or adequate protection of human health and the environment. alternative.	The City of Ionia and the Michigan Dept. of Public Health preclude the installation of a drinking water well at or near the site. The risk reduction provided by this alternative is derived from the enactment of institutional controls continuing to restrict the use of water from the shallow water-bearing zone and maintenance of the existing landfill cover and vegetation.	The risk reduction provided by this alternative is derived from the reduction of contaminant levels in groundwater over time. Overall protectiveness would not be sufficiently improved over current conditions as a stand-alone remedy at this site.	The risk reduction provided by this alternative is derived from the reduction of contaminant levels in groundwater over time and transferred to the Kanouse Drain and eventually the Grand River. This alternative would likely result in an unacceptable risk to the human health and the environment in the Kanouse Drain.	The risk reduction provided by this alternative is derived from the reduction of contaminant levels in groundwater over time and transferred to the City of Ionia's water treatment plant. This alternative may satisfy protectiveness criteria for human health and the environment if the water treatment plant will accept and adequately treat the waste water.	The risk reduction provided by this alternative is derived from the reduction of contaminant levels in groundwater through treatment at the site. If groundwater is remediated to achieve applicable federal and state groundwater quality standards, any residual risk would be further reduced. The air emissions from the air stripper stack were modeled and the magnitude of risk associated with air emissions from the treatment process are negligible. This alternative satisfies protectiveness criteria for human health and the environment.	The risk reduction provided by this alternative is derived from the reduction of contaminant levels in groundwater through treatment at the site. If groundwater is remediated to achieve applicable federal and state groundwater quality standards, any residual risk would be further reduced. Carbon treatment waste would be taken to and disposed of at an approved waste facility. This alternative satisfies protectiveness criteria for human health and the environment.

Ground-water Comparative Analysis

Nine Criteria	Alt. 1 No Action	Alt. 2 Institutional Controls	Alt. 3 Monitored Natural Attenuation	Alt. 4 Extraction Without Treatment and Discharge to Surface Water	Alt. 5 Extraction Without Treatment and Discharge to POTW	Alt. 6 Extraction, Air Stripper and Discharge to POTW	Alt. 7 Extraction, Liquid-Phase Carbon Absorption and Discharge to POTW
Compliance with Applicable or Relevant & Appropriate Requirements (ARARs)	Current contaminant concentrations in groundwater at the site exceed applicable State and Federal water quality standards for several of the compounds. This alternative does not meet all ARARs.	This alternative does not meet all ARARs.	Without groundwater treatment, this alternative does not meet all ARARs.	Without groundwater treatment, this alternative is not likely to meet all ARARs.	Without groundwater treatment, this alternative is not likely to meet all ARARs.	On-site treatment and natural processes will reduce contaminant concentrations in the groundwater to meet all chemical -, location - and action-specific ARARs when the remedy is complete.	On-site treatment and natural processes will reduce contaminant concentrations in the groundwater to meet all chemical -, location - and action-specific ARARs when the remedy is complete.

Ground-water Comparative Analysis

Nine Criteria	Alt. 1 No Action	Alt. 2 Institutional Controls	Alt. 3 Monitored Natural Attenuation	Alt. 4 Extraction Without Treatment and Discharge to Surface Water	Alt. 5 Extraction Without Treatment and Discharge to POTW	Alt. 6 Extraction, Air Stripper and Discharge to POTW	Alt. 7 Extraction, Liquid-Phase Carbon Absorption and Discharge to POTW
Long-term Effectiveness and Permanence	Effectiveness and permanence of this alternative is very poor based on existing transport mechanisms and exposure routes. With this alternative, the magnitude of residual risks would not be reduced although natural attenuation may reduce these levels over time.	If institutional controls restricting groundwater use at the site are implemented and enforced, potential exposure of the public to the impacted site groundwater would be eliminated. If the property were to be developed at a future date, controls over the type of development and type of construction activities allowed at the site specified in a deed restriction would minimize exposure to the public. The magnitude of residual risk is primarily dependent on the effectiveness of preventing use of the site and groundwater in the long-term.	Although there is evidence to indicate that natural attenuation processes are occurring, no focused study to determine if conditions are favorable for natural attenuation processes and determine the rate of natural attenuation has been conducted; consequently, its effectiveness at the Ionia City Landfill is unknown. If monitored natural attenuation is occurring and is selected as a sole remedy, the remedial time frame is likely to be long. If selected as part of a containment or treatment remedy, natural attenuation would occur more quickly.	This alternative would provide for a long-term reduction in risks due to ingestion of groundwater; however, if the groundwater were untreated prior to release, the risks would be transferred to surface water where the public may be exposed. The effectiveness of this method is limited by the rate at which the chlorinated solvents can be extracted and diluted in the surface water body. Residual risk would be associated with air and soil/sediments impacted by this action. An increase in the mobility of groundwater contaminants would be expected through volatilization.	The long-term effectiveness of this method is limited by the rate at which the chlorinated solvents can be extracted from the aquifer and whether the POTW can accept and treat the extracted groundwater.	Site risks would be reduced. On-site treatment of groundwater would capture and contain the high concentration VOC plume (>500 µg/l) and effectively treat/remove the high concentrations of volatile organic compounds. The likelihood that the on-site treatment of groundwater will meet efficiency and performance considerations is good. Site contaminants are readily eliminated by the treatment process. Based on evaluation of monitoring data, system operating parameters would be adjusted or system modifications implemented so that the system effectiveness would be optimized if necessary.	Site risks would be reduced. On-site treatment of groundwater would capture and contain the high concentration VOC plume (>500 µg/l) and effectively treat/remove the high concentrations of volatile organic compounds and transfer them to the vapor phase. The likelihood that the on-site treatment of groundwater will meet efficiency and performance considerations is high. Site contaminants are readily eliminated by the treatment process. Based on evaluation of monitoring data, system operating parameters would be adjusted or system modifications implemented so that the system effectiveness would be optimized if necessary.

Ground-water Comparative Analysis

Nine Criteria	Alt. 1 No Action	Alt. 2 Institutional Controls	Alt. 3 Monitored Natural Attenuation	Alt. 4 Extraction Without Treatment and Discharge to Surface Water	Alt. 5 Extraction Without Treatment and Discharge to POTW	Alt. 6 Extraction, Air Stripper and Discharge to POTW	Alt. 7 Extraction, Liquid-Phase Carbon Absorption and Discharge to POTW
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment (TMV)	This alternative does not address principal site threats or incorporate the statutory preference for treatment as a means to permanently or significantly reduce TMV of hazardous substances at the site.	This alternative does not address principal site threats or incorporate the statutory preference for treatment as a means to permanently or significantly reduce TMV of hazardous substances at the site. No reduction of mobility, toxicity, or volume would be expected other than that associated with natural mechanisms.	As a stand-alone alternative, this alternative does not address principal site threats or incorporate the statutory preference for treatment as a means to permanently or significantly reduce TMV of hazardous substances at the site. No reduction in toxicity, mobility or volume is expected other than that provided by natural attenuation mechanisms.	No reduction in toxicity, mobility or volume is expected other than that provided by dilution or natural attenuation mechanisms. This alternative does not address the statutory preference for treatment.	Toxicity, mobility and volume of contaminants would be reduced through the POTW treatment processes. This alternative may address the statutory preference for treatment if the City of Ionia will accept the untreated waste water.	On-site treatment of groundwater by air stripping would result in the removal of the volatile organic compounds present in the high concentration VOC plume (>500 µg/l). VOCs outside the 500 µg/l plume would be expected to be reduced through natural processes. This alternative addresses the statutory preference for treatment.	On-site treatment of groundwater by liquid -phase carbon absorption would result in the removal of the volatile organic compounds present in the high concentration VOC plume (>500 µg/l). VOCs outside the 500 µg/l plume would be expected to be reduced through natural processes. This alternative addresses the statutory preference for treatment.

Ground-water Comparative Analysis

Nine Criteria	Alt. 1 No Action	Alt. 2 Institutional Controls	Alt. 3 Monitored Natural Attenuation	Alt. 4 Extraction Without Treatment and Discharge to Surface Water	Alt. 5 Extraction Without Treatment and Discharge to POTW	Alt. 6 Extraction, Air Stripper and Discharge to POTW	Alt. 7 Extraction, Liquid-Phase Carbon Absorption and Discharge to POTW
Short-term Effectiveness	Short-term effectiveness does not apply to this alternative.	Short-term increased exposure to site workers and nearby residents and environmental impacts during remedial actions would be minimal and centered on fence construction, site maintenance and monitoring well installation activities. The alternative can be implemented in a very short time span since it does not involve large-scale or sophisticated operations.	Short-term exposure of the public to hazardous materials along with safety considerations are low. Potential environmental impacts are associated with the installation of any additional wells.	Short-term risks are associated with exposure to workers during construction activities. The risk of exposure to the public would also be increased as the impacted groundwater would be discharged without treatment to the Kanouse Drain or Grand River.	Since the system has already been implemented under the removal action, there are no risks associated with system installation. Any remaining risks would be due to repairs or modifications to the system but can be easily controlled through implementation of proper health and safety procedures/ controls.	Since the system has already been implemented under the removal action, there are no risks associated with system installation. Any remaining risks would be due to repairs or modifications to the system but can be easily controlled through implementation of proper health and safety procedures/controls.	Since the air stripper system has already been implemented under the removal action, the only remaining risk would be due to modification made to it for carbon treatment. Any remaining risks would be due to repairs or modifications to the system but can be easily controlled through implementation of proper health and safety procedures/controls.

Ground-water Comparative Analysis

Nine Criteria	Alt. 1 No Action	Alt. 2 Institutional Controls	Alt. 3 Monitored Natural Attenuation	Alt. 4 Extraction Without Treatment and Discharge to Surface Water	Alt. 5 Extraction Without Treatment and Discharge to POTW	Alt. 6 Extraction, Air Stripper and Discharge to POTW	Alt. 7 Extraction, Liquid-Phase Carbon Absorption and Discharge to POTW
Implementa-bility	This alternative presents no implement ability problems due to the lack of any alternative elements.	This alternative presents no significant problems with respect to technical feasibility of the technologies involved with implementation. No problems are anticipated with regards to availability of equipment, materials, and services.	Prior to implementation, a study would be required to obtain the hydrogeologic and geochemical data necessary. This study could be readily implemented.	Based on evaluation of monitoring data, system operating parameters would be adjusted or system modifications designed/implemente d so that the system effectiveness would be optimized e.g. if required, additional groundwater recovery wells can be added to enhance recovery/containment of all or a portion of the 500 µg/l plume. The feasibility of this alternative is considered poor based on the high likelihood that approval for untreated discharge would not be granted.	The extraction system has already been implemented. Modifications would be necessary to remove the air stripper from the system. The system would be optimized during design to ensure that proper pumping rates are achieved to obtain hydraulic control of the impacted area. The feasibility of this alternative is considered poor based on the high likelihood that approval for untreated discharge would not be granted.	The extraction system and air stripper have already been implemented under a previous action. Additional extraction wells can be installed to further control the 500 µg/l plume and/or perform long-term monitoring. A discharge permit from the local POTW has already been approved.	The extraction system and air stripper have already been implemented under the remova action. Modification would be necessary to install the carbon treatment. Additional extraction wells can be installed to further control the 500 µg/l plume. A discharge permit from the local POTW has already been approved.
Cost	$0	$526,000	$652,000	$1.3 million	$1.3 million	$1.3 million	$1.4 million
State Acceptance	No	No, if stand-alone Yes, if combined with other actions	No, if stand-alone Yes, if combined with other actions	No	No	No, if stand-alone Yes, if combined with other actions	No, if stand-alone Yes, if combined with other actions
Community Acceptance	A complete summary of public comments can be found in the attached Responsiveness Summary.						

K. PRINCIPAL THREAT WASTES

The NCP establishes an expectation that U.S. EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

Although no "threshold level" of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or future site use.

The 1994 removal action removed the known source(s) of drums and contaminated soil in Area A. There are no known sources in Area B. In addition, it was determined that implementation of a pump and treat system with an air stripper could capture and remediate the source area of the groundwater plume defined by the 500 µg/l total VOC boundary. While some questions remain concerning capture and remediation of the 500 µg/l total VOC source plume, there is evidence that the existing pump and treat system is going a long way towards achieving the performance goals established under the removal action.

Through implementation of the earlier removal action and selection of the source and groundwater alternatives in this ROD, principal threat wastes are being treated.

L. SELECTED REMEDY

This section of the ROD will be organized into three sections: 1) Description, Rationale and Estimated Costs for the Selected Remedy, and 2) Expected Outcomes of Selected Remedy

Description, Rationale and Estimated Costs for the Selected Remedy

Based on information in the Administrative Record and presented in this ROD, the U.S. EPA selects Groundwater Alternative 2 - Institutional Controls, Groundwater Alternative 3 - Monitored Natural Attenuation for the dissolved portion of the VOC plume, and Groundwater Alternative 6 - Groundwater Extraction, Air Stripper and Discharge to POTW for the 500 μg/l source plume of the VOC plume.

Selected Remedy

Selected Remedy:

Groundwater Alternatives 2, 3, and 6 - Institutional Controls, Monitored Natural Attenuation, and Groundwater Extraction, Airstripping, and Discharge to the POTW

Estimated Capital Cost: $156,600
Annual O & M Cost: $166,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $2.2 million
Estimated Time to Implement: Immediate

The selected final groundwater remedy consists of the existing recovery and treatment of groundwater associated with the contaminant plume identified in the A-1 Aquifer. Groundwater is currently being extracted from the wells using submersible pumps and routed through a network of underground pipes to a central holding tank located in an on-site treatment building. It is then treated through airstipping . Periodic draw-down measurements and sampling of monitoring wells installed down-gradient from the recovery wells will be required to verify the effectiveness and adequacy of the recovery well network in containing/treating the 500 µg/l total VOC plume and achieving and sustaining federal MCLs at the waste boundary through natural processes over time and MDEQ GSI discharge limits at the Grand River and Kanouse Drain over time. Recovery of contaminated groundwater may involve modifications to contain and treat the 500 µg/l total VOC plume and achieve and sustain MCLs and GSI discharge limits if monitoring indicates that the existing system is insufficient. Current effluent from the system is being discharged to the sanitary sewer. Influent and effluent sampling and analysis is required to verify proper operation of the system and as a condition of a local discharge permit.

Monitored natural attenuation (MNA) will be implemented for the contaminant plume outside the influence of the pump and treat system. Monitoring will include, at a minimum:

- Contaminants of concern and their potential degradation by-products (i.e., daughter products) as determined from literature searches.
- Routine Indicator Parameters, including pH, dissolved oxygen, Eh (a.k.a.: Redox, or Oxidation/Reduction Potential), temperature, and specific electrical conductance.
- Indicator Parameters necessary to evaluate continued MNA, such as: alkalinity, chloride, nitrite, nitrate, dissolved methane, iron (II) and iron (III), chloride, sulfate, sulfide, total organic carbon, etc.
- Vertical and horizontal characterization of contaminant and hydraulic conductivity distributions.

- Seasonal variations and trends to determine if changes in contaminant concentrations, indicator parameters or *water types* may be attributed to natural attenuation or seasonal variability. To determine seasonal variations, the effects of different, potential influences on water quality (such as recharge events, pumping effects, etc.) need to be documented.

Table 7 presents the most important contaminants of concern and the federal and state standards that must be met under this ROD.

Table 7 - Federal and State Standards for Contaminants of Concern Detected in Groundwater

Chemical	Federal Maximum Concentration Limit (ug/L)	Grand River Chronic GSI Discharge Limit (ug/L)	Grand River Acute GSI Discharge Limit (ug/L)	Kanouse Drain Chronic GSI Discharge Limit (ug/L)	Kanouse Drain Acute GSI Discharge Limit (ug/L)
trichloroethene	5	N/A	3,500	200	3,500
cis-1,2-dichloroethene	70	N/A	11,000	620	11,000
1,1-dichloroethane	N/A	N/A	N/A	740	N/A
vinyl chloride	2	N/A	N/A	15	N/A
arsenic	50	N/A	N/A	150	N/A
chromium	100	N/A	3,700	240	3,700
copper	1,300	N/A	99	30	99
manganese	50*	N/A	5,300	1,200	5,300
zinc	N/A	N/A	1,100	560	1,100

* secondary MCL

Institutional controls will be implemented to restrict exposure to potential hazards at the site. Institutional controls will include:

- Maintenance of the site including vegetative cover, perimeter fencing, warning signs - "Danger-Unauthorized Personnel Keep Out/Hazardous Waste Site" and all other appropriate support facilities.

- Use of deed restrictions to control development of the property.

- Continued and/or enhanced controls to prevent future use of the contaminated groundwater. The City of Ionia currently precludes the installation of a drinking water well or irrigation wells at or near the site.

Lastly, residential development in Areas A and B is prohibited. Commercial or industrial development of Areas A and B may be allowed so long as it does not adversely impact groundwater remediation at the site.

Remedy Rationale

A number of actions have been implemented to prevent direct contact with groundwater under the landfill. In 1984, clay was added to areas of obvious depressions in the landfill cover. On completion of the point source removal in 1994, sand obtained from an off-site source was used to backfill the excavation and an 18-inch cap composed of clay/clay-rich material was placed over the sand backfill. These measures have been effective in reducing or eliminating potential dermal contact and ingestion and will be maintained.

As noted, the point source of buried drums and drum-related material and associated soil was removed during the 1994 removal action and the resulting excavation was backfilled with sand and an 18-inch cap composed of clay/clay-rich material was placed over the sand backfill. This cover serves to minimize infiltration and contaminant leaching to groundwater. The remaining portion of the landfilled, non-hazardous municipal waste is covered with native soil or clay which, based on the results of the landfill clay cap investigation, provides a variable amount of infiltration reduction through the non-hazardous material. Infiltration and the resultant leaching contaminants to groundwater will continue to be minimized.

Another potential exposure pathway includes ingestion of surface water, or fish which have been impacted by surface water contaminant transport/release to the to the Grand River. Also relevant is dermal contact with sediments or surface water which have been effected by the same mechanism. Additionally, dermal contact or ingestion of contaminated on-site soil and inhalation of contaminated dust and vapors from volatilization of contaminants from contaminated waste could result if erosion of the landfill cap exposes contaminated waste.

The current point source and landfill cover prevent direct surface water contact with the residual contaminants and non-hazardous municipal waste. Erosion of the soil cover and clay cap materials which might expose the landfill contents will be controlled.

Results from investigations at the site have shown that the shallow groundwater at the site has been impacted by the former point source in Area A. The potential pathway of ingestion of contaminated groundwater is unlikely as there are no current or likely future groundwater receptors at this site. However, to protect potential downgradient receptors and environmental media, a removal action for the site was implemented in Area A, where the highest contaminant concentrations were detected in the groundwater. A pump and treatment system has been installed to contain the 500 ug/L plume. Iron fouling has caused the existing system to go down periodically. However, new equipment has been installed and maintenance frequency has been increased to reduce or eliminate the time that the current pump and treat system is down. Questions remain concerning the existing system's ability to contain/treat the 500 ug/L plume. Data from groundwater monitoring will be used to evaluate the system effectiveness, adjust operating parameters and determine any system modifications that are necessary. This may include the installation of additional extraction wells and treatment capacity or passive enhancements like a collection trench.

Based on information in the administrative record and developed using the BIOCHLOR model, monitored natural attenuation is a viable remedy for the VOCs detected downgradient of the 500 ug/L plume, assuming the current groundwater extraction system captures the 500 ug/L plume.

Evaluating groundwater flow conditions outside the 500 ug/L plume were evaluated for all contaminants in the groundwater. However, the primary downgradient contaminants of concern are *cis*-1,2-DCE and vinyl chloride. Trichloroethene (TCE) is considered a site contaminant; however, TCE is not detected in any of the downgradient wells and is, therefore, not considered a contaminant of concern downgradient from the site.

The Grand River located to the south of the site is at an elevation lower than all monitoring wells in the A-1 unit. Therefore, the Grand River is considered the main and final discharge point for the majority of groundwater in the A-1 aquifer. The exception to this would be at times of accelerated run off during spring months or storm events when the river would rise faster than the local water table reversing the hydraulic gradient. During those times the Grand River would and begin to feed the local flow system temporarily. A short term event such as this would not affect overall flow at the site but would temporarily widen and deflect any contaminant plume entering the river.

The hydraulic gradient in the area south of the 500 ug/L plume is approximately 0.0015 ft/ft based on the 1999 sampling event. This gradient is much lower than the hydraulic gradient to the north of the 500 ug/L contour which was approximately 0.01 ft/ft. This indicates that as contaminants moved downgradient from the point-source area, groundwater flow slows down giving contaminants more time to break down.

Based on the BIOCHLOR model, the degradation to below 2 ug/L MCL for VC is 900 feet. The estimate for degradation to below the 70 ug/L MCL for *cis*-1,2, DCE is approximately 400 feet. The distance to the Grand River in the south - southwest

direction along an approximated flowline is between 1,000 and 1,500 feet which would indicate that there is more than adequate distance between the contour of the 500 ug/L plume and Grand River for attenuation to take place. Distances to the eastern and western site boundaries and the Kanouse Drain are less but are still expected to achieve MCLs or GSI discharge limits, as appropriate, over time.

There are limitations associated with this model and a more conclusive evaluation of natural attenuation will require a more sophisticated model (e.g., MODFLOW/RT3D) and more downgradient monitoring wells to further delineate the plume. Currently the best data for evaluating contaminant transport at the site is the conceptual model supported by the analytical data and the BIOCHLOR model.

Addition of more wells will be necessary to monitor natural attenuation for contaminants downgradient of the 500 ug/L plume. Chlorinated solvent plumes are typically long and narrow, often 100 feet wide or less and require a tight monitoring network to fully assess the plume. Currently there is approximately 500 feet of unmonitored groundwater between MW-12 and MW-10R. Monitored natural attenuation will require more wells than are currently downgradient of the contaminant plume.

The groundwater plume downgradient and outside of the groundwater removal action capture zone (500 ug/L zone) does not pose a current excess risk to the aquatic environment of the Grand River or Kanouse Drain and consequently, engineered remediation of the entire groundwater plume is not necessary. Chronic and acute discharge values were calculated for a number of contaminants of concern at the Kanouse Drain. These are presented in Table 8.

Table 8 - Chronic and Acute Discharge Limits for the Kanouse Drain (ug/L)

Chemical	Chronic Discharge Limit	Acute Discharge Limit
trichloroethene	200	3,500
cis-1,2-dichloroethene	620	11,000
1,1-dichloroethane	740	N/A
vinyl chloride	15	N/A
arsenic	150	N/A
chromium	240	3,700
copper	30	99
manganese	1,200	5,300
zinc	560	1,100

Except for vinyl chloride, all other contaminants of concern are not currently exceeding either the chronic or acute discharge limits based on the most recent groundwater sampling in February 1999. In addition, this groundwater sampling event occurred prior to start up of the pump and treat system. Taking a closer look at the chronic discharge limit of 15 ug/L for vinyl chloride reveals that its basis is in human health protection. An ecologically protective discharge limit is 930 ug/L based on the revised Mixing Zone Determination dated September 14, 2000. State regulations require selection of the more stringent of the health protection thresholds; however, from a reasonable future use perspective, the Kanouse Drain does not supply sufficient water to be considered as a potential drinking water source or represent an excess human health risk. The ecological systems in and adjacent to the Kanouse Drain are more authentic benchmarks for evaluating adverse impacts due to continuing discharges of vinyl chloride to the Kanouse Drain. According to the revised Mixing Zone Determination, that limit is 930 ug/L, or nearly 4.5 times greater that the highest concentrations found near the Kanouse Drain before the pump and treat system was operating.

Therefore, U.S. EPA believes that capture of the 500 ug/L plume, along with natural processes to reduce contaminants, particularly vinyl chloride near the Kanouse Drain, over time will protect human health and the environment.

Since ARARs must be attained at completion of remedial action and federal MCLs will need to be met east of the Kanouse Drain in Area A, GSI discharge limits are likely to be achieved and sustained at the Kanouse Drain before federal MCLs are achieved and sustained at the waste boundary.

The current pump and treat system and natural attenuation monitoring address the remedial action objectives of containment and treatment of the plume, reducing further migration from the source area, and controlling cross media migration of contaminants from groundwater to surface water.

Expected Outcomes of Selected Remedy

Current and future expected uses for the site include commercial or industrial interests. Residential development is currently and will continue to be prohibited. Commercial and industrial interests may be restricted due to flood plain designations or interference with the existing pump and treat system. Continued operation and maintenance of the pump and treat system will occur until the Federal MCLs at the waste boundary or the GSI discharge limits at the Kanouse Drain and Grand River are achieved and can be sustained.

Implementation of the selected remedy will reduce groundwater contaminant concentrations to acceptable levels based on a reasonably expected reuse for the site.

M. STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, the U.S. EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

Implementation of the selected remedy will adequately protect human health and the environment through maintenance of the existing soil cover, the continued operation and maintenance of the existing pump and treat system which captures and treats the 500 ug/L VOC isoplath, and natural attenuation and monitoring of the groundwater not influenced by the existing pump and treat system. Institutional Controls will continue to prohibit the use of the aquifer until federal MCLs at the waste boundary or the MDEQ GSI discharge limits at the Kanouse Drain and Grand River are achieved and can be sustained.

Compliance with ARARs

Section 121(d) of CERCLA requires that Superfund remedial actions meet applicable or relevant and appropriate requirements (ARARs). In addition to ARARs, the ARARs analysis which was conducted considered guidelines, criteria, and standards useful in evaluating remedial alternatives. These guidelines, criteria, and standards are known as "To Be Considered" (TBCs). In contrast to ARARs, which are promulgated cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations; TBCs are guidelines and other criteria that have not been promulgated.

A requirement may be either "applicable" or "relevant and appropriate" to a remedial action. Applicable requirements are cleanup standards, criteria, or requirements under Federal or promulgated State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements may not be "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, but they do address problems or situations sufficiently similar to those encountered at the CERCLA site so that their use is well suited to the particular site.

Even though there are several types of ARARS, they are divided into three separate groups: chemical-specific, location-specific, and action-specific.

Chemical-specific ARARs are requirements which set health or risk-based concentration limits or ranges for specific hazardous substances, pollutants, or contaminants. Maximum Contaminant Levels (MCLS) and National Air Quality Standards are examples of chemical-specific ARARS.

Location-specific ARARs set restrictions on activities based upon the characteristics of the site and/or the nearby areas. Examples of this type of ARAR include Federal and State siting laws for hazardous waste facilities and sites on the National Register of Historic Places.

The third classification of ARARs, action-specific, refers to requirements that set controls or restrictions on particular activities related to the management of hazardous substances, pollutants, or contaminants. Resource Conservation and Recovery Act (RCRA) regulations for closure of hazardous waste storage units, RCRA incineration standards, and pretreatment standards under the Clean Water Act for discharges to Publicly Owned Treatment Works (POTWs) are examples of action-specific ARARS.

Actual ARARs can be identified only on a site-specific basis. They depend on the detected chemicals at a site, specific site characteristics, and particular remedial actions proposed for the site. ARARs must be attained by completion of the remedial action unless a waiver is invoked. The groundwater remedy for the site, which includes the existing pump and treat system that captures and treats the 500 ug/L VOC contaminant plume, monitored natural attenuation for the groundwater not influenced by the pump and treat system, and institutional controls, will meet all ARARs over time.

ARARs identified for the Ionia City Landfill site are discussed below.

CHEMICAL-SPECIFIC ARARS

As previously stated, chemical-specific ARARs set health-based or risk-based concentration limits or ranges for specific hazardous substances, pollutants and/or contaminants. Tables A-1 and A-2 present a review of the potential Federal and State chemical-specific ARARS. Some of the chemical-specific ARARs that may apply to the Ionia City landfill site are discussed below.

Federal Chemical-Specific ARARs

Maximum Contaminant Levels for Drinking Water

The Federal Safe Drinking Water Act provides for the establishment of drinking water standards for public water systems. These standards are "applicable" only to public water systems as defined by the Act and regulations. However, they may be considered "relevant and appropriate" as ARARs for potential groundwater exposure via drinking water [U.S. EPA, Superfund Public Health Evaluation Manual (Oct. 1986)]. Although the A-1 aquifer is not currently used as a drinking water source, the potential

exists for such use; therefore, drinking water standards are considered ARARs for Remediation Alternatives.

The primary "maximum contaminant levels" (MCL) for organic chemicals are considered ARARs (CERCLA Directive 9284.0-05). Primary MCLs are enforceable standards establishing maximum permissible levels of contaminants in drinking water. (See 40 CFR 142).

In addition to the pesticides and total trichloromethanes, MCLs are set for the following organic chemicals: benzene, vinyl chloride, carbon tetrachloride, 1,2-dichloroethane, trichloroethylene, 1,1-dichloroethylene, 1,1,1-trichloroethane, cis-1,2 dichloroethylene, 1,2 dichloropropane, ethylbenzene, monochlorobenzene, o-dichlorobenzene, styrene, tetrachloroethylene, para-dichlorobenzene, toluene, trans-1,2 dichloroethylene, total xylenes, dichloromethane, 1,2,4-trichlorobenzene, and 1,1,2-trichloroethane (40 CFR 141.61). MCLs for inorganic chemicals include: arsenic, barium, cadmium, chromium, mercury, nitrate, total nitrate and nitrite, selenium, antimony, beryllium, cyanide, thallium, and fluoride (40 CFR 141.62 and 40 CFR 141.11). Standards for turbidity, microbiological and radiological contaminants are also established.

The Safe Drinking Water Act also provides for establishment of secondary MCLs. These are designated to "control contaminants in drinking water that primarily affect the aesthetic qualities relating to public acceptance of drinking water" [40 CFR 143.1]. The regulations note that secondary MCLs "in the judgment of the Administrator (of EPA) are requisite to protect the public welfare" [40 CFR 143.2 (f)]. Federal secondary MCLs are set for aluminum, chloride, color, copper, corrosivity, fluoride, foaming agents, iron, manganese, odor, pH, silver, sulfate, total dissolved solids, and zinc (40 CFR 143.3). Table 2-1A lists federal standards/guidance for indicator compounds detected in the groundwater.

Federal Water Quality Criteria

Section 304(a) of the Clean Water Act requires EPA to develop water quality criteria related to protection of human health and aquatic life. EPA has developed criteria for numerous substances. The Federal water quality criteria do not have regulatory impact and are therefore not "applicable" to the cleanup. However, since they do set levels which prevent toxicity they may be considered "relevant and appropriate".

Under Section 121(d)(2)(A) of SARA, the remedy selected must "require a level or standard of control which at least attains ... water quality criteria established under Section 304 or 303 of the Clean Water Act, where... such criteria are relevant and appropriate under the circumstances of time release or threatened release". SARA further provides that "in determining whether or not any water quality criteria under the Clean Water Act is relevant and appropriate under the circumstances of the releases, (EPA) shall consider the designated or potential use of the surface or groundwater, the

environmental media affected, the purposes for which such criteria were developed, and the latest information available" [Section 121(d)(2)(B)(i) of SARA].

The ambient water quality criteria for acute and chronic toxicity to fresh water aquatic life are relevant and appropriate for any discharge from the site to nearby surface water.

Release from Solid Waste Management Units

The RCRA regulations under 40 CFR Part 264 Subpart F establish maximum contaminant concentrations that can be released from hazardous waste management units. Although there are no hazardous waste management units on-site, the RCRA regulations do consider releases of hazardous substances into groundwater. Therefore, these requirements are "relevant and appropriate".

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) has resulted in the establishment of regulations concerning the manufacture, processing, distribution, use, disposal, storage, and marking of PCB items. Additionally, TSCA establishes spill cleanup standards. EPA policy dictates that the PCB spill policy be considered during implementation of CERCLA actions. The policy is found at 40 CFR Part 761 Subpart G. No PCB wastes have been detected at the Ionia City Landfill, therefore these requirements are not applicable and are not relevant or appropriate.

Clean Air Act

Review of the Clean Air Act (CAA) identifies the National Ambient Air Quality Standards (NAAQS's) as potential ARAR's. However, NAAQS's are ARAR's only when the remedial activity (groundwater treatment in this case) is a "major" source of emissions (EPA, 1989). A major source is defined as one that emits 250 tons per year of a regulated pollutant in a CAA attainment area or 100 tons per year in a non-attainment area. The groundwater treatment system at the Ionia City landfill site has the potential to emit regulated pollutants but is not anticipated to be a major emission source. Therefore, these requirements are "relevant and appropriate".

State Chemical-Specific ARARs

Mixing Zone Determination Discharge Limits

The Michigan Department of Environmental Quality calculated chronic and acute discharge limits for the Kanouse Drain and Grand River. These discharge limits are shown in Table 7, on page 61. As shown on Table 7, these discharge limits are considered applicable to the Ionia City Landfill site.

Michigan state chemical-specific ARARs are identified in Table A-2.

LOCATION-SPECIFIC ARARs

Location-specific ARARs are requirements that set restrictions on activities based on the location and characteristics of the site and nearby areas. Tables A-3 and A-4 present a review of potential Federal and State location-specific ARARS.

ACTION-SPECIFIC ARARs

ARARs applicable to the implementation of remedial action alternatives at the site are action-specific ARARs. Potential action-specific ARARs applicable to the Ionia City Landfill site are presented in Tables A-5 and A-6.

Cost-Effectiveness

U.S. EPA has determined that the selected remedy is cost effective. Section 300.430 (f)(1)(ii)(D) of the NCP requires U.S. EPA to evaluate cost effectiveness by comparing all the alternatives that meet the threshold criteria (protection of human health and the environment and compliance with ARARs) against three balancing criteria (long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness). The selected remedies meet these criteria by achieving a permanent protection of human health and the environment at low risk to the public, and provide for overall effectiveness in proportion to their cost.

The Superfund program does not mandate the selection of the most cost effective cleanup alternative. The most cost effective remedy is not necessarily the remedy that provides the best balance of tradeoffs with respect to the remedy selection criteria nor is it necessarily the least-costly alternative that is both protective of human health and the environment and ARAR-compliant. Cost effectiveness is concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options.

The total net present worth of the selected remedy is $2.2 million.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

U.S. EPA believes that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Ionia City Landfill site.

Short-Term Effectiveness and Implementability

The selected remedy does not pose excessive short-term risks. In fact, since the groundwater extraction and treatment system that has been selected as part of this remedy is already in place and has been operational since May 1999, there are no short-term effectiveness or implementability issues as to that component of the remedy. Any short-term increased exposure to site workers and nearby residents, and environmental impacts during implementation of the institutional controls and installation of the monitoring wells would be minimal. Similarly, there are no special implementability issues for the other aspects of this remedy. There are no technical barriers to implementation of the institutional controls component of the selected remedy. As to the monitored natural attenuation component of the remedy, a study is required prior to implementation to obtain necessary hydrogeologic and geochemical data. This study can be readily implemented.

Preference for Treatment as a Principal Element

Based on current information, U.S. EPA believes that the selected remedy is protective of human health and the environment and utilizes permanent solutions to the maximum extent possible. The remedy does satisfy the statutory preference for treatment of the hazardous substances present at the site as a principal element through the continued operation of the existing pump and treat system and long-term monitoring.

Five-year Review Requirements

The NCP, at 40 C.F.R. § 300.430(f)(4)(ii), requires a five-year review if the remedial action results in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. Because this remedy will result in hazardous contaminants remaining on-site above levels that allow for unlimited use, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

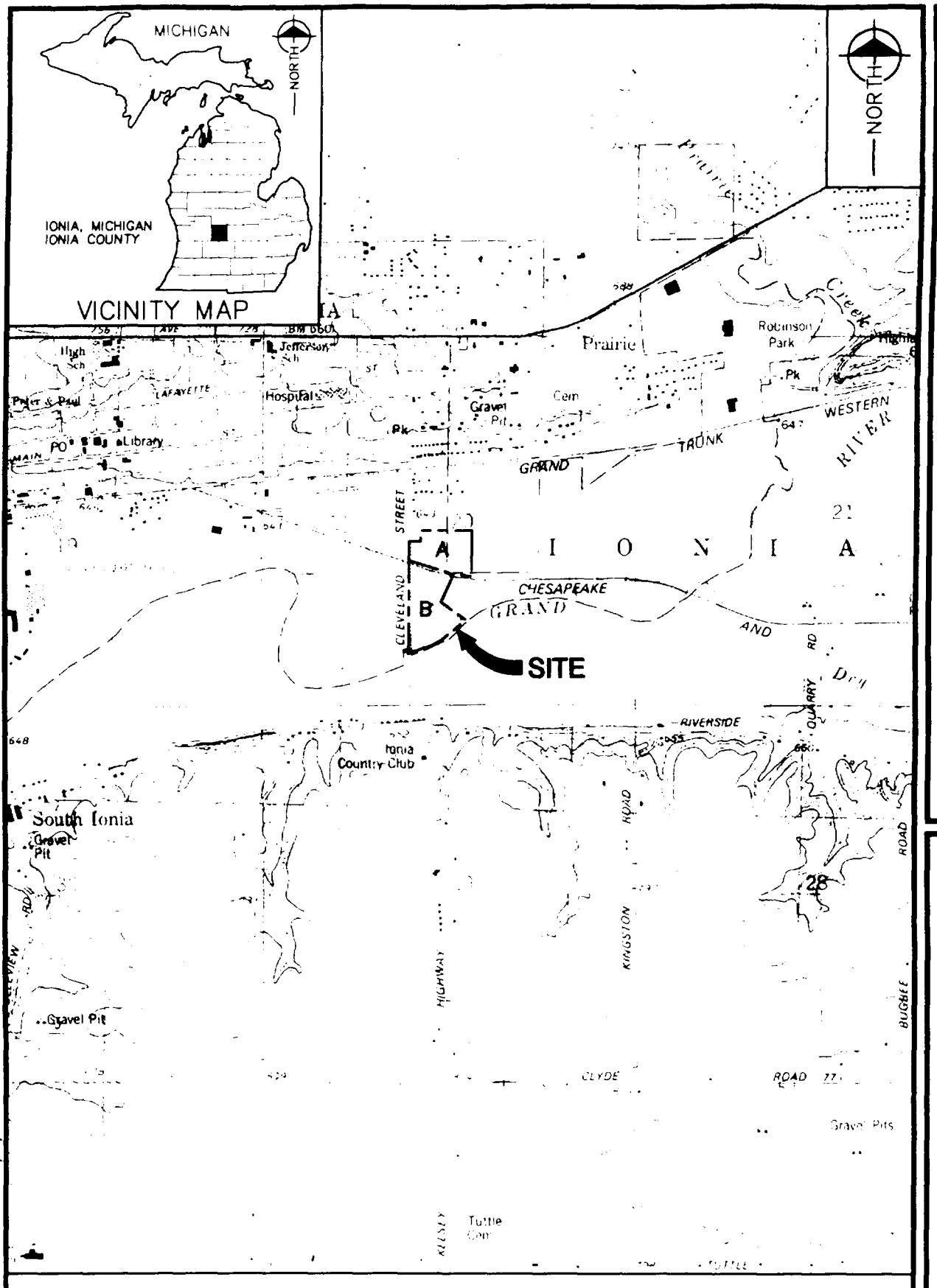
N. DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

To fulfill CERCLA 117(b) and NCP [40 C.F.R. §§ 300.430(f)(5)(iii)(B) and 300.430(f)(3)(ii)(A)], the ROD must document and discuss the reasons for any significant changes made to the Selected Remedy.

The Proposed Plan was released for public comment in July 2000. It identified Groundwater Alternatives 2, 3, and 6 as the preferred alternatives for groundwater. There are no significant changes from the Proposed Plan groundwater alternative and U.S. EPA selects Groundwater Alternatives 2, 3, and 6 and the final groundwater remedy for the Ionia City Landfill site.

The Proposed Plan also identified and selected a soil clean-up alternative. Instead of specifically selecting a soil alternative, this ROD has discussed the removal activities that have already been undertaken at this site, and why no further soil remedy needs to be selected for the site because the principal threat from soils has already been addressed. The elements of the Source Method Cleanup Alternative SM-2 and SM-3, which required restricting access, restricting development of certain areas of the site, prohibiting drinking water wells, and providing monitoring and maintenance of the site, have been incorporated into the groundwater remedy outlined in this ROD.

Figures



REFERENCE:
IONIA, MI QUADRANGLE
7.5 MINUTE SERIES
DATED: 1978
Maptech(r) U.S. Terrain Series(tm),
(c)maptech, Inc. 603-433-8500

SITE LOCATION MAP

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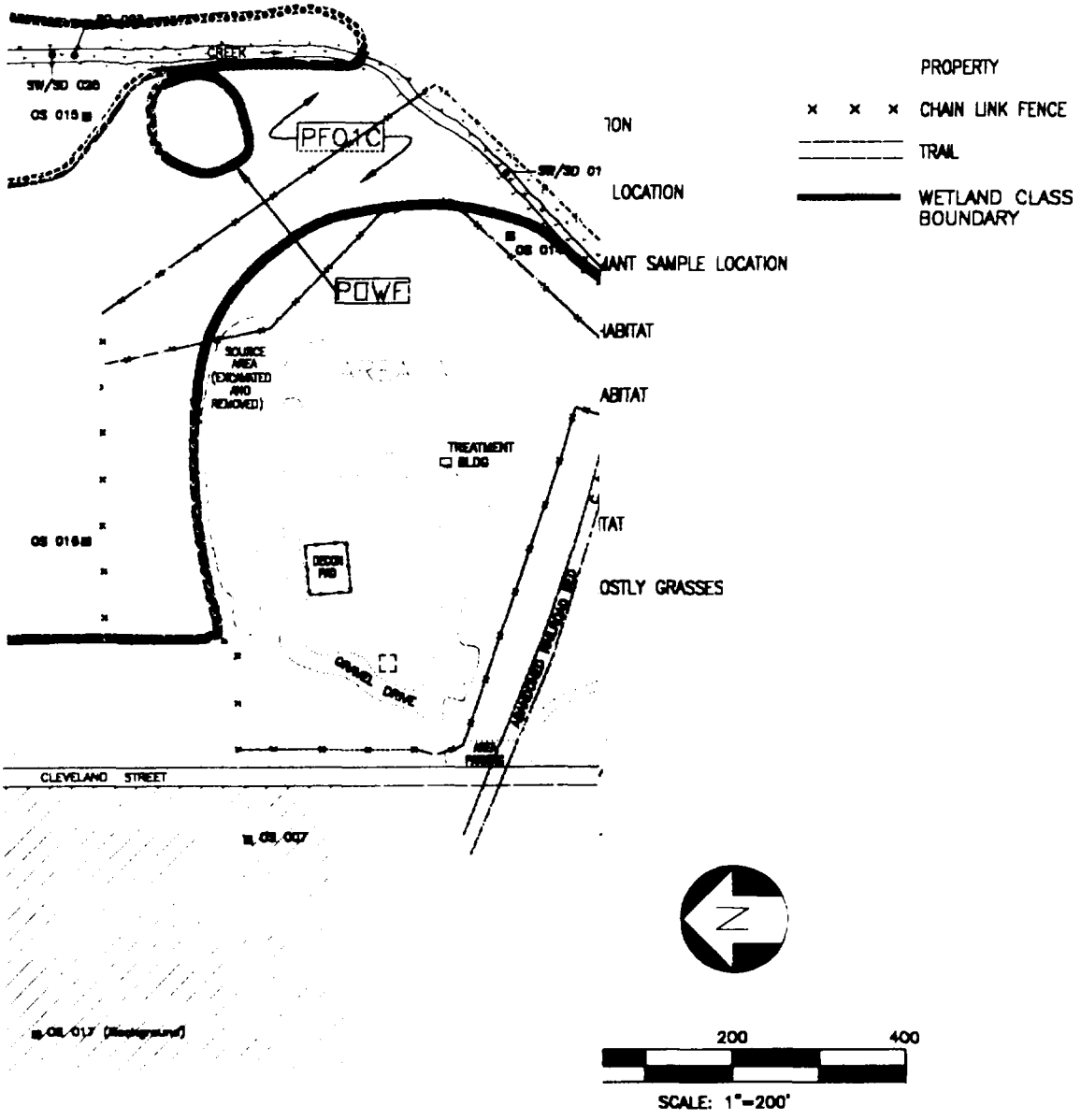
Ionia City Landfill
Ionia, Michigan

Groundwater Monitoring Report

PROJECT NO.
96227B

FIGURE NO.
1

PLOT INFO: 96227A\CD\FIGURE-1.DWG DATE: 06/22/2000 TIME: 8:50 AM USER: DSM



POWF: SEMIPERMANENTLY FLOODED PALUSTRINE OPEN WATER WITH UNKNOWN BOTTOM.

PFO1A: TEMPORARILY FLOODED, FORESTED PALUSTRINE BROAD-LEAVED DECIDUOUS.

PFO1C: SEASONALLY FLOODED, FORESTED PALUSTRINE BROAD-LEAVED DECIDUOUS.

* WETLAND CLASSIFICATIONS OBTAINED FROM U.S. FISH AND WILDLIFE SERVICE, NATIONAL WETLAND

Former Ionia City Landfill
Ionia, Michigan

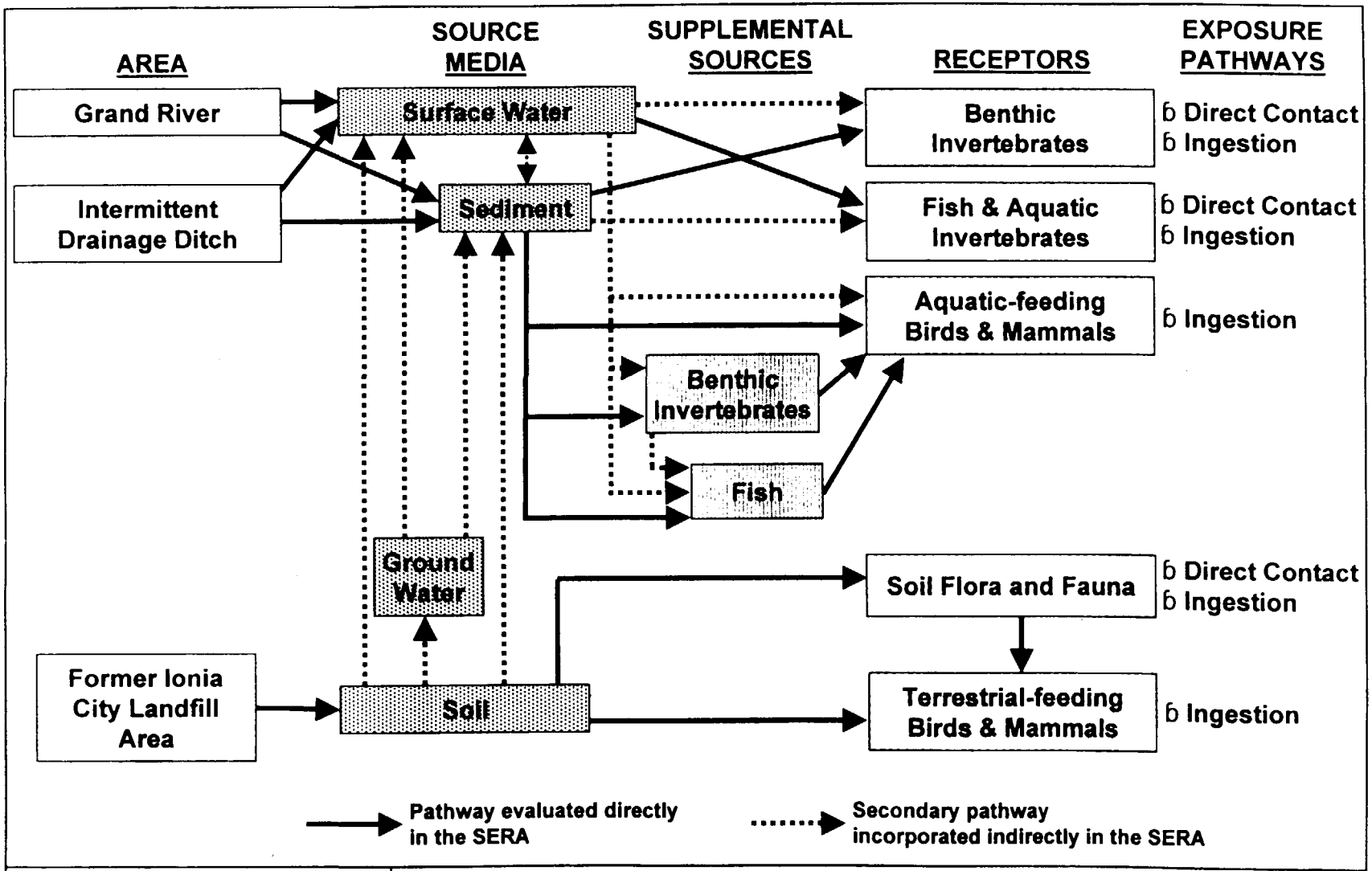
McLaren Hart ENVIRONMENTAL ENGINEERING CORPORATION

DRWN:tml/cem	DATE: 12/98
CHKD	DATE: 3/99
APPD	DATE
SCALE	AS SHOWN

Site Vegetation/Habitat Map

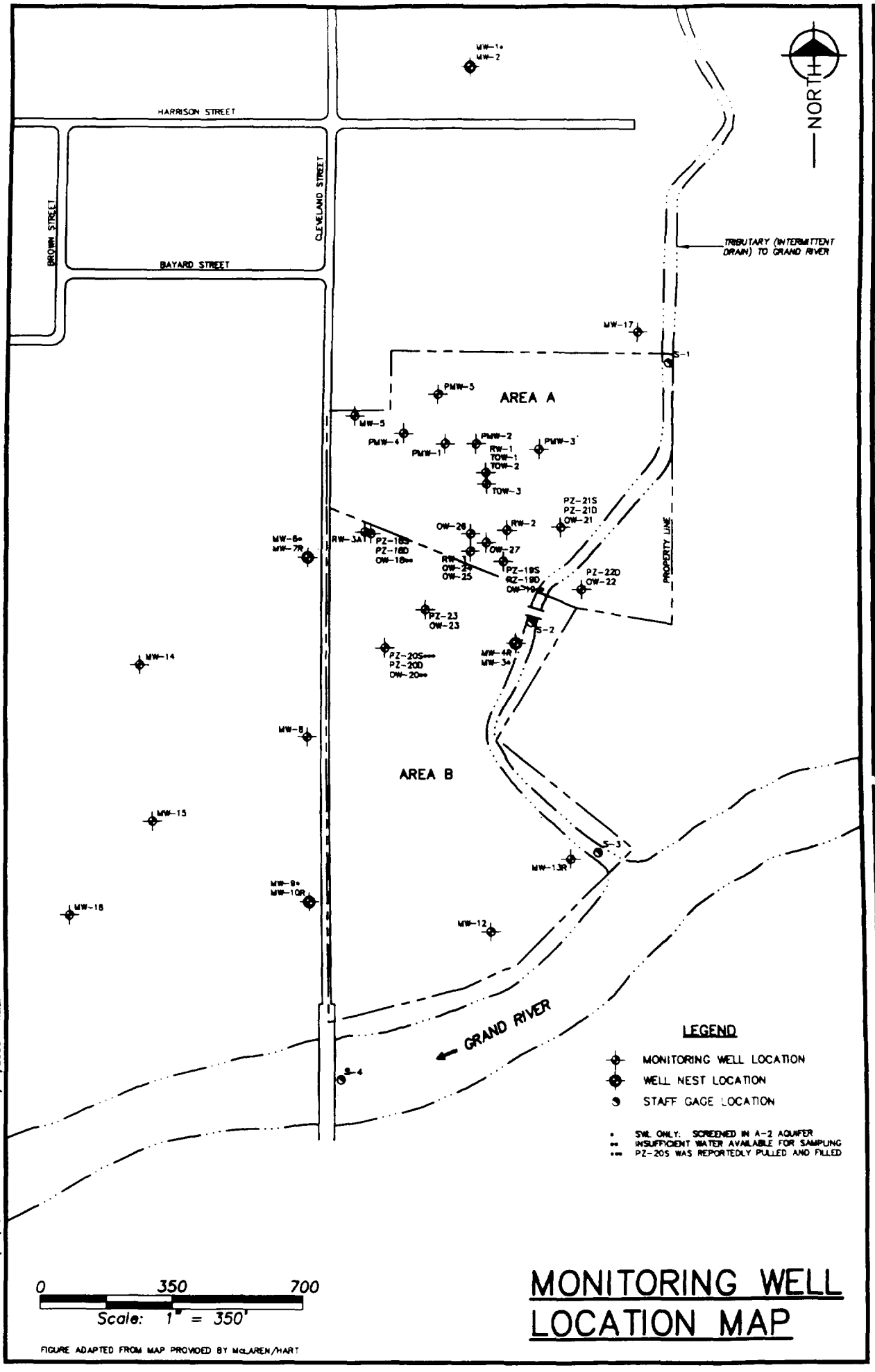
Filename: ...\Ionia\Figures\Site.dwg
Plot File: ...\r\misc\standard.pc2

DRAWING NUMBER
FIG. 2



ChemRisk
A Service of McLaren/Hart

Figure 3
Conceptual Site Model for the Former Ionia City Landfill Site



MONITORING WELL LOCATION MAP

FIGURE ADAPTED FROM MAP PROVIDED BY McLAREN/HART

PLOT INFO: 96227A\CD\FIGURE-4.DWG DATE: 06/22/2000 TIME: 10:01 AM USER: DSM

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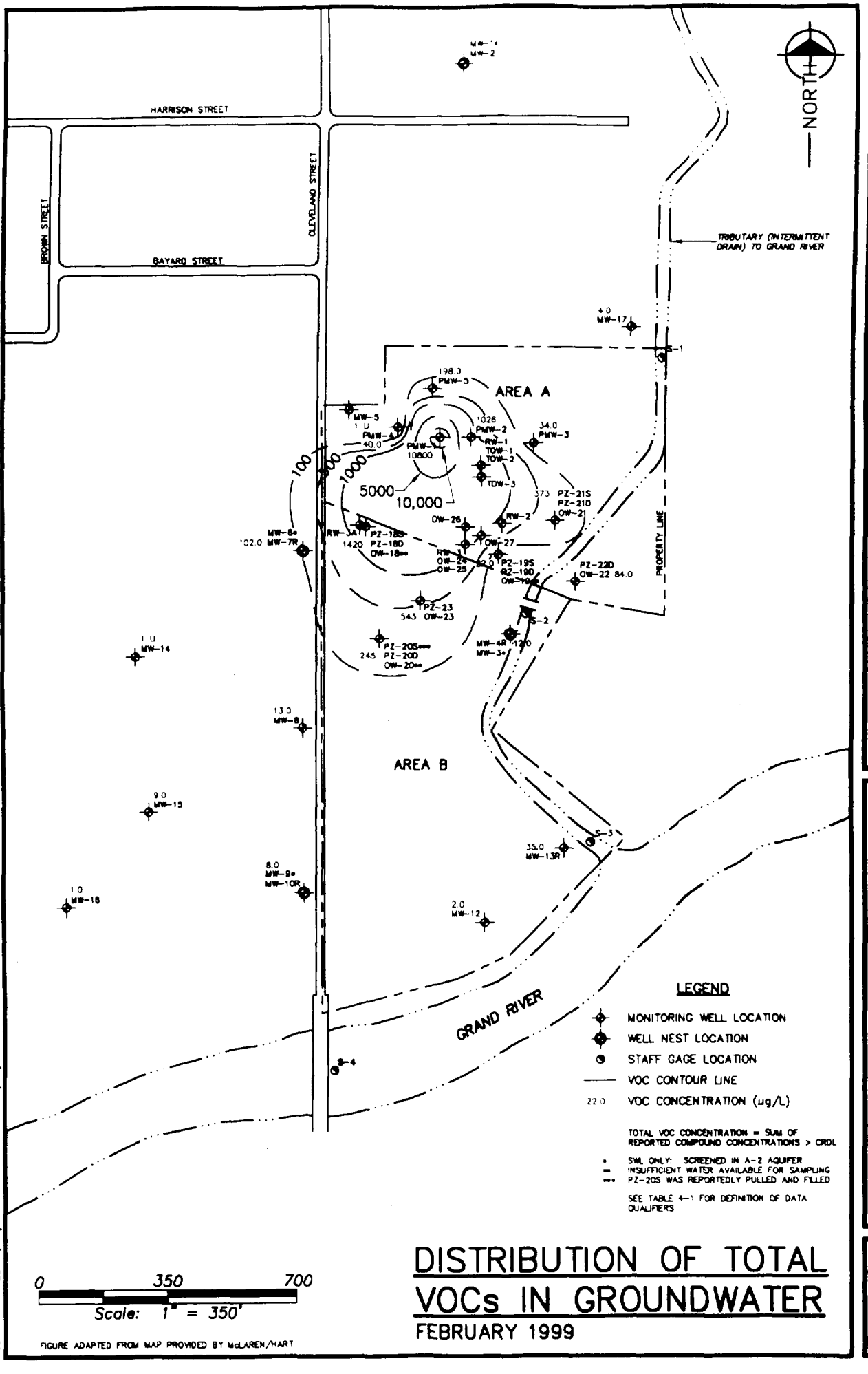
Ionia, Michigan

Groundwater Monitoring Report

PROJECT NO
96227B

FIGURE NO
4



DISTRIBUTION OF TOTAL VOCs IN GROUNDWATER

FEBRUARY 1999

FIGURE ADAPTED FROM MAP PROVIDED BY McLAREN/HART

PLOT INFO: 96227A\CD\FIGURE-5.DWG DATE: 06/22/2000 TIME: 10:52 AM USER: DSM

N: \96227A\PRJ \AUG96227A.DWG

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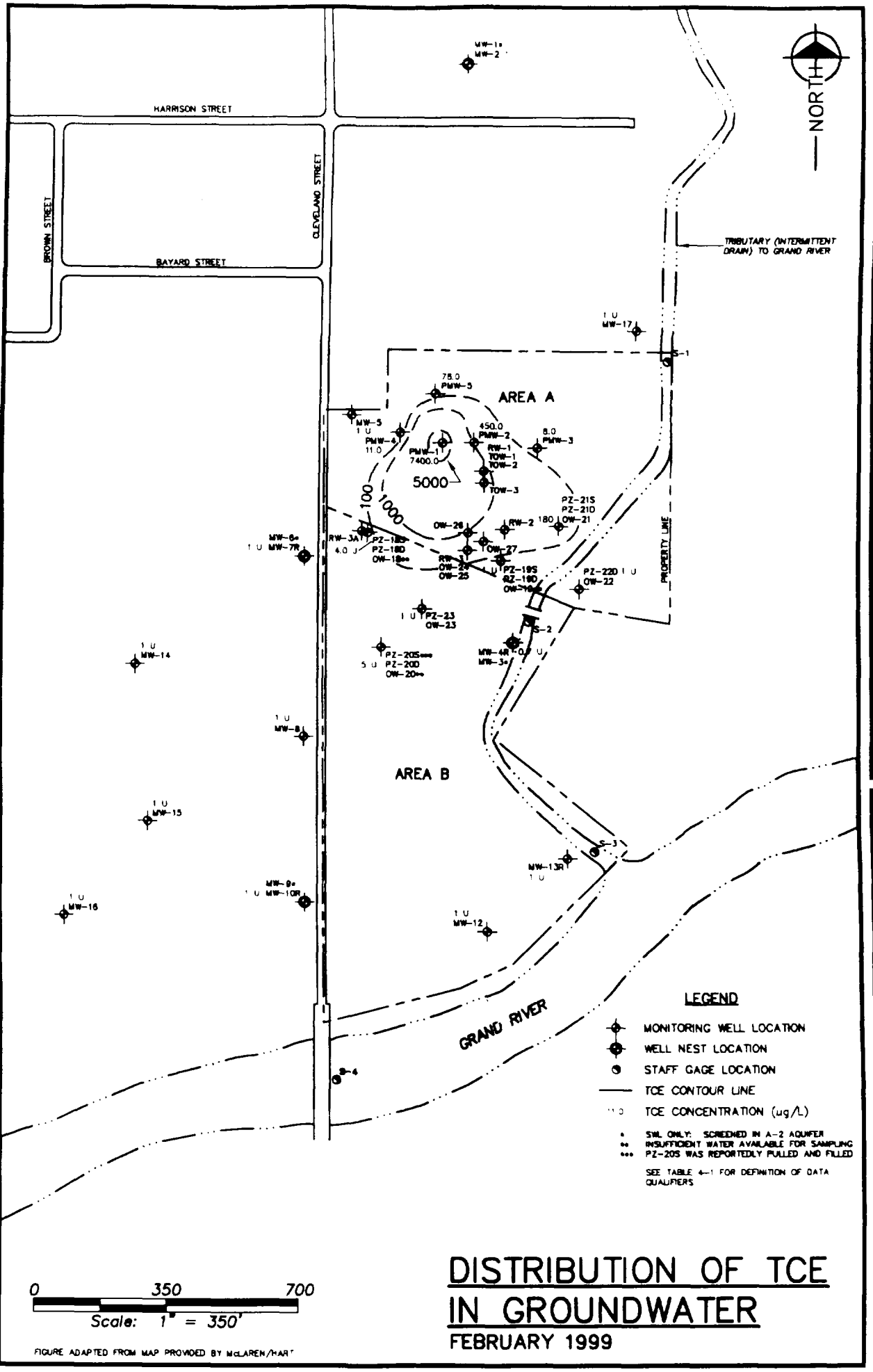
Ionia, Michigan

Groundwater Monitoring Report

PROJECT NO
96227B

FIGURE NO
5



DISTRIBUTION OF TCE IN GROUNDWATER

FEBRUARY 1999

FIGURE ADAPTED FROM MAP PROVIDED BY McLAREN/HART

PLOT INFO: 96227A\CD\FIGURE-6.DWG DATE: 08/26/2000 TIME: 10:50 AM USER: DSM

N:\96227A\CD\FIGURE-6.DWG

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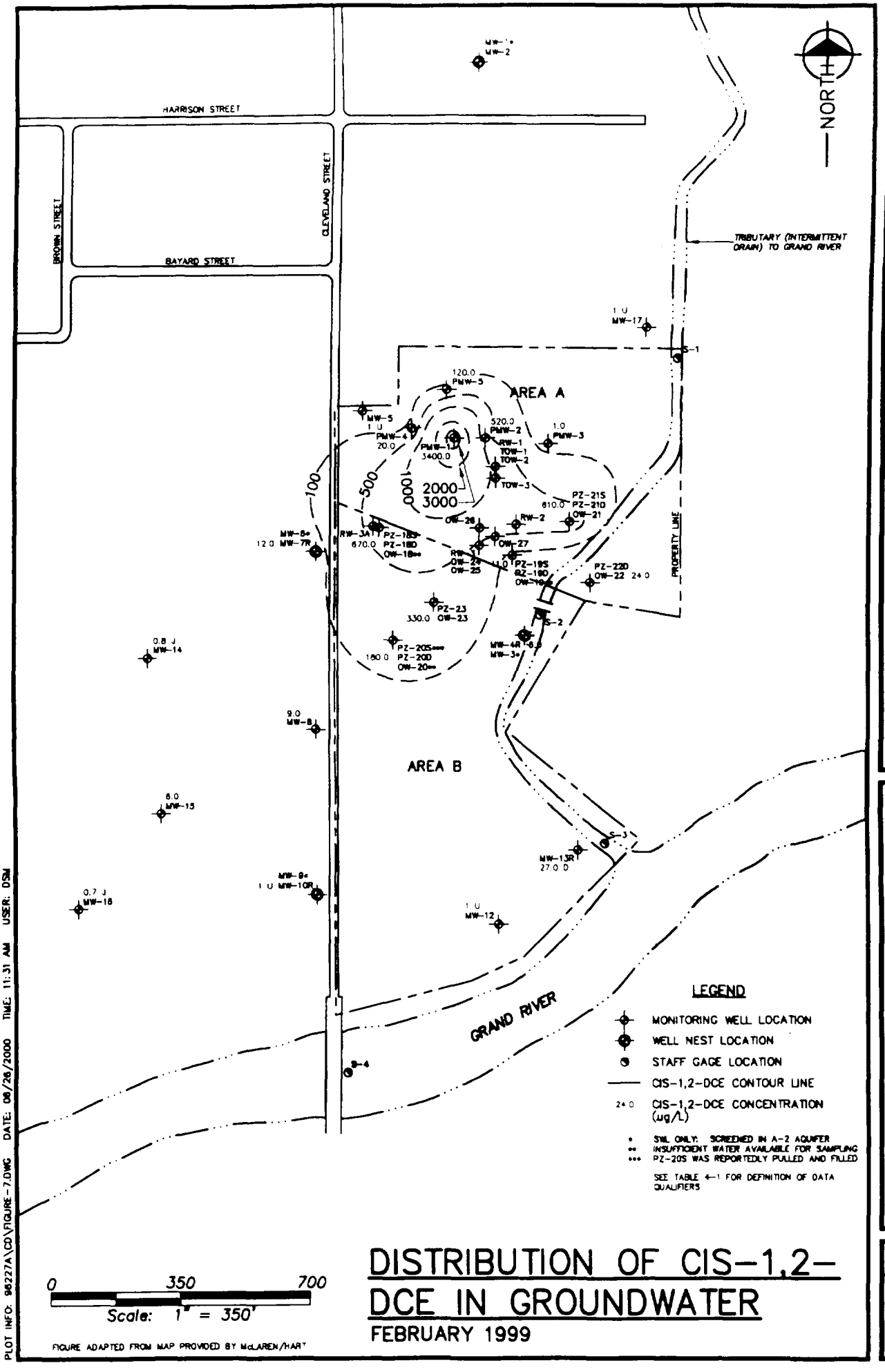
Ionia City Landfill
Ionia, Michigan

Groundwater Monitoring Report

PROJECT NO
96227B

FIGURE NO
6



DISTRIBUTION OF CIS-1,2-DCE IN GROUNDWATER

FEBRUARY 1999

FIGURE ADAPTED FROM MAP PROVIDED BY McLAREN/HART

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ftch

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Ionia, Michigan

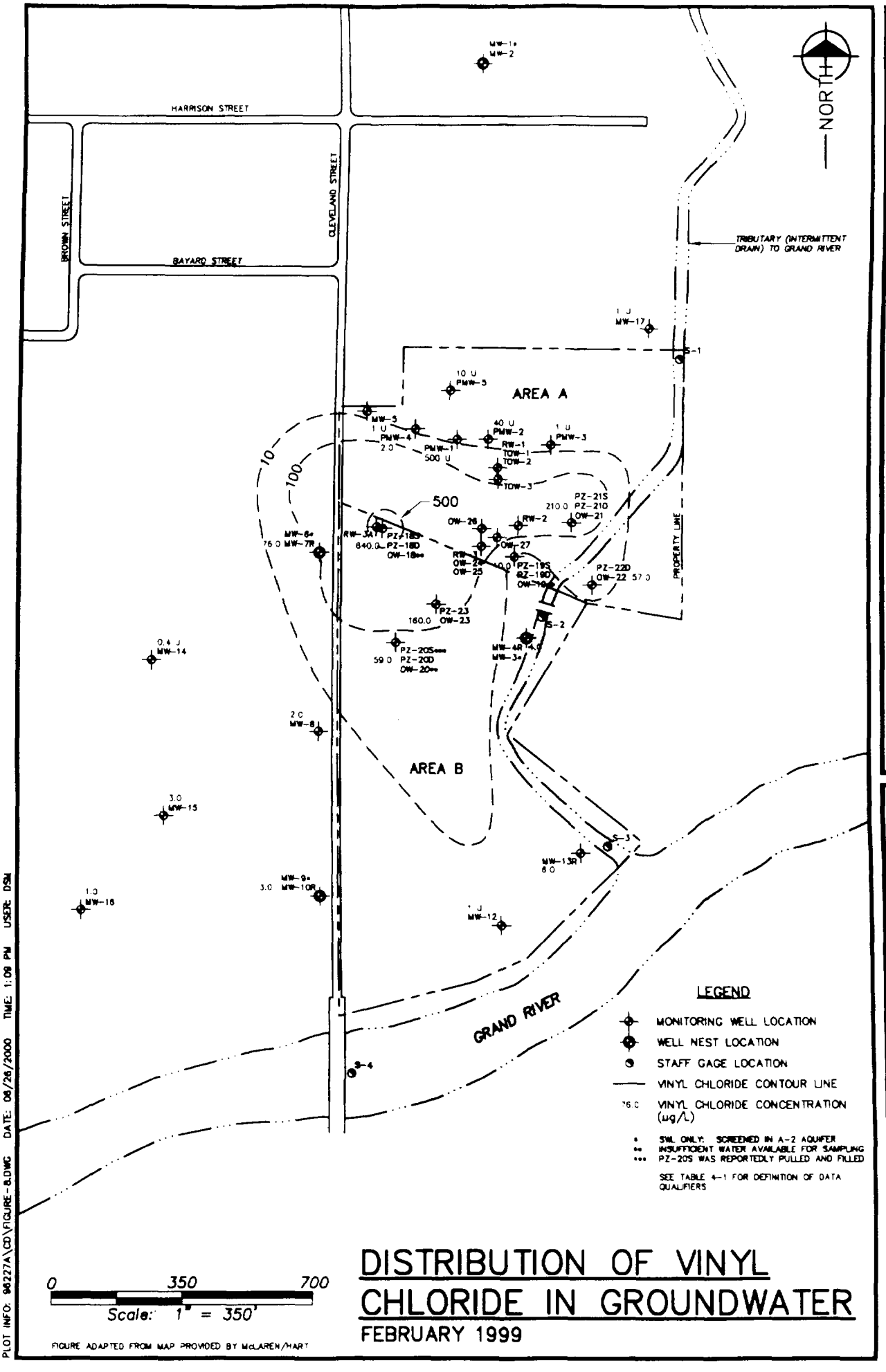
Groundwater Monitoring Report

PROJECT NO
96227B

FIGURE NO
7

PLOT INFO: 96227A\CD\FIGURE-7.DWG DATE: 08/26/2000 TIME: 11:31 AM USER: DSM

N:\96227A\CD\FIGURE-7.DWG



DISTRIBUTION OF VINYL CHLORIDE IN GROUNDWATER

FEBRUARY 1999

FIGURE ADAPTED FROM MAP PROVIDED BY McLAREN/HART

PLOT INFO: 96227A\CD\FIGURE-8.DWG DATE: 06/26/2000 TIME: 1:09 PM USER: DSM

N:\96227A\CD\FIGURE-8.DWG

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Grand Rapids, Michigan

Ionia City Landfill
Ionia, Michigan

Groundwater Monitoring Report

PROJECT NO
96227B

FIGURE NO
8

Contamination Tables

Table 1 • Volatile Organic Data Summary
Baseline Groundwater Monitoring Report
Ionia City Landfill
June 1999

Well Number		MW-2	MW-4R	MW-5	MW-7R	MW-8	MW-8 Duplicate	MW-10R	MW-12	MW-13R	MW-13R Duplicate	MW-14	MW-15
Comment													
Collection Date		02/02/99	02/11/99	02/02/99	02/09/99	02/03/99	02/03/99	02/08/99	02/03/99	02/11/99	02/11/99	02/15/99	02/10/99
Parameter	Units												
1,1,1-Trichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	ug/L	1 U	**1**	1 U	**12**	**1**	**1**	**4**	1 U	1 U	1 U	1 U	0.8 J
1,1-Dichloroethene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropan	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromoethane (EDB)	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone (MEK)	ug/L	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
2-Hexanone	ug/L	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
4-Methyl-2-pentanone (MIBK	ug/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	ug/L	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
Benzene	ug/L	1 U	**1**	1 U	**2**	1 U	1 U	**1**	1 U	**1**	1 U	1 U	1 U
Bromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	ug/L	1 U	1 UJ	1 U	1 UJ	1 U	1 U	1 U	1 U	1 UJ	1 U	1 UJ	1 UJ
Carbon disulfide	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	ug/L	1 UJ	1 U	1 UJ	1 U	1 UJ	1 UJ	1 U	1 UJ	1 U	1 U	1 U	1 U
Chloroform	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	ug/L	1 U	**6**	1 U	**12**	**9**	**10**	1 U	1 U	**27 D**	**28 D**	0.8 J	**6**
cis-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Styrene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	1 U	1 UJ	1 U	1 UJ	1 U	1 U	1 U	1 U	1 UJ	1 UJ	1 UJ	1 UJ
Toluene	ug/L	**3**	0.9 U	1 U	0.6 U	**1**	**1**	1 U	**1**	1 U	0.5 U	1 U	1 U
trans-1,2-Dichloroethylene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**1**	0.8 J	1 U	1 U
trans-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	ug/L	1 U	0.7 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	ug/L	1 U	**4**	1 U	**76 D**	**2**	**2**	**3**	1 U	**6**	**5**	0.4 J	**3**
Xylenes	ug/L	**2**	0.7 U	1 U	0.6 U	1 U	1 U	1 U	**1**	1 U	0.5 U	1 U	1 U

Data Qualifiers:
U Analyzed for but not detected.
J Estimated value.
R Result is rejected due to a deficiency in ability to analyze the sample and meet quality control criteria. Presence or absence of the target analyte cannot be verified.
D Value obtained from a diluted reanalysis.
Bolded values indicate reported concentration at or above the CRDL.

Table 1 • Volatile Organic Data
Baseline Groundwater Monitoring R
Ionia City Landfill
June 1999

Well Number		MW-16	MW-17	OW-21	OW-22	OW-23	OW-23 Duplicate	PMW-1	PMW-2	PMW-3	PMW-4	PMW-5	PZ-18D
Comment													
Collection Date		02/10/99	02/04/99	02/16/99	02/09/99	02/08/99	02/08/99	02/16/99	02/16/99	02/15/99	02/10/99	02/15/99	02/09/99
Parameter	Units												
1,1,1-Trichloroethane	ug/L	1 U	1 U	**28**	1 U	1 U	1 U	340 J	**56**	**10**	**3**	10 U	50 U
1,1,2,2-Tetrachloroethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,1,2-Trichloroethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,1-Dichloroethane	ug/L	1 U	1 U	**34**	**3**	**43 D**	**44 D**	260 J	28 J	**15**	**3**	10 U	**110**
1,1-Dichloroethene	ug/L	1 U	1 U	10 U	1 U	**2**	**2**	500 U	40 U	1 U	1 U	10 U	50 U
1,2-Dibromo-3-chloropropan	ug/L	1 U	1 U	10 UJ	1 U	1 U	1 U	500 UJ	40 UJ	1 UJ	1 U	10 U	50 U
1,2-Dibromoethane (EDB)	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,2-Dichlorobenzene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,2-Dichloroethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,2-Dichloropropane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,2,4-Trichlorobenzene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,3-Dichlorobenzene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
1,4-Dichlorobenzene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
2-Butanone (MEK)	ug/L	5 UR	5 UR	50 UR	5 UR	5 UR	5 UR	2500 UR	200 UR	5 UR	5 UR	50 UR	250 UR
2-Hexanone	ug/L	5 UR	5 UR	50 UR	5 UR	5 UR	5 UR	2500 UR	200 UR	5 UR	5 UR	50 UR	250 UR
4-Methyl-2-pentanone (MIBK	ug/L	5 U	5 U	50 UJ	5 U	5 U	5 U	2500 UJ	200 UJ	5 U	5 U	50 U	250 U
Acetone	ug/L	5 UR	5 UR	50 UR	5 UR	5 UR	5 UR	2500 UR	200 UR	5 UR	5 UR	50 UR	250 UR
Benzene	ug/L	1 U	1 U	10 U	1 U	**2**	**2**	500 U	40 U	1 U	1 U	10 U	50 U
Bromochloromethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Bromodichloromethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Bromoform	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Bromomethane	ug/L	1 UJ	1 U	10 UJ	1 UJ	1 U	1 U	500 UJ	40 UJ	1 UJ	1 UJ	10 U	50 UJ
Carbon disulfide	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Carbon tetrachloride	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Chlorobenzene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Chloroethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Chloroform	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Chloromethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
cis-1,2-Dichloroethene	ug/L	0.7 J	1 U	**110**	**24**	**330 D**	**340 D**	**3400**	**520**	**1**	**20**	**120**	**670**
cis-1,3-Dichloropropene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Dibromochloromethane	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Ethylbenzene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Methylene chloride	ug/L	2 U	2 U	20 U	2 U	2 U	2 U	1000 U	80 U	2 U	2 U	20 U	100 U
Styrene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Tetrachloroethene	ug/L	1 UJ	1 U	4 J	1 UJ	1 U	1 U	500 U	40 U	1 U	1 UJ	10 UJ	50 UJ
Toluene	ug/L	0.6 U	**2**	10 U	0.8 J	1 U	1 U	500 U	40 U	1 U	0.9 U	10 U	50 U
trans-1,2-Dichloroethylene	ug/L	1 U	1 U	10 U	1 U	**6**	**6**	500 U	40 U	1 U	**1**	10 U	50 U
trans-1,3-Dichloropropene	ug/L	1 U	1 U	10 U	1 U	1 U	1 U	500 U	40 U	1 U	1 U	10 U	50 U
Trichloroethene	ug/L	1 U	1 U	**180**	1 U	1 U	1 U	**7400**	**450**	**8**	**11**	**78**	50 U
Vinyl chloride	ug/L	1 U	1 U	10 U	**57 D**	**160 D**	**160 D**	500 U	40 U	1 U	**2**	10 U	**640**
Xylenes	ug/L	0.6 U	**2**	10 U	0.8 J	1 U	1 U	500 U	40 U	1 U	0.8 U	10 U	50 U

Data Qualifiers:
U Analyzed for but not detected.
J Estimated value.
R Result is rejected due to a defic
D Value obtained from a diluted
Bolded values indicate reported co

Table 1 • Volatile Organic Data
Baseline Groundwater Monitoring R
Ionia City Landfill
June 1999

Well Number		PZ-18S	PZ-19D	PZ-19S	PZ-20D	PZ-21D	PZ-21S	PZ-22D	PZ-23	Field Blank #1	Field Blank #2	Field Blank #3	Field Blank #4
Comment													
Collection Date		02/09/99	02/08/99	02/04/99	02/11/99	02/16/99	02/16/99	02/08/99	02/08/99	02/03/99	02/08/99	02/09/99	02/15/99
Parameter	Units												
1,1,1-Trichloroethane	ug/L	5 U	1 U	1 U	5 U	8 J	5 J	1 U	1 U	1 U	1 U	1 U	0.5 J
1,1,2,2-Tetrachloroethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	ug/L	24	1 U	1 U	4 J	260	66	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2 Dibromo-3-chloropropar	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2 Dibromoethane (EDB)	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2 Dichloropropane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3 Dichlorobenzene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4 Dichlorobenzene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone (MEK)	ug/L	25 UR	5 UR	5 UR	25 UR	200 UR	100 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
2-Hexanone	ug/L	25 UR	5 UR	5 UR	25 UR	200 UR	100 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
4 Methyl-2 pentanone (MIBI	ug/L	25 U	5 U	5 U	25 U	200 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	ug/L	25 UR	5 UR	5 UR	25 UR	200 UR	100 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
Benzene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromochloromethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	ug/L	5 UJ	1 U	1 U	5 UJ	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 UJ	1 U
Carbon tetrachloride	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 UJ	1 U	1 U	1 U
Chloromethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2 Dichloroethene	ug/L	95	1 U	11	180 D	610	280	1 U	6	1 U	1 U	1 U	1 U
cis-1,3 Dichloropropene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	ug/L	10 U	2 U	2 U	10 U	80 U	40 U	2 U	2 U	2 U	2 U	1 U	0.7 J
Styrene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	5 UJ	1 U	1 U	5 UJ	40 UJ	20 UJ	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 UJ	1 UJ
trans 1,2-Dichloroethylene	ug/L	5 U	1 U	1 U	6	8 J	20 U	1 U	1 U	1 U	1 U	1 U	0.6 J
trans 1,3-Dichloropropene	ug/L	5 U	1 U	1 U	5 U	40 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	ug/L	4 J	1 U	1 U	5 U	52	18 J	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	ug/L	34	1 U	10	59	210	27	1 U	1 U	1 U	1 U	1 U	0.8 J
Xylenes	ug/L	5 U	1 U	1	5 U	40 U	20 U	1 U	1	1 U	1 U	1 U	1 U
													0.8 J

Data Qualifiers:
U Analyzed for but not detected.
J Estimated value.
R Result is rejected due to a defi
D Value obtained from a diluted
Bolded values indicate reported co

Table 1 • Volatile Organic Data
Baseline Groundwater Monitoring R
Ionia City Landfill
June 1999

Well Number Comment Collection Date		Trip Blank #1 02/03/99	Trip Blank #2 02/04/99	Trip Blank #3 02/09/99	Trip Blank #4 02/09/99	Trip Blank #5 02/11/99	Trip Blank #6 02/15/99
Parameter	Units						
1,1,1-Trichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropar	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromoethane (EDB)	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone (MEK)	ug/L	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
2-Hexanone	ug/L	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
4-Methyl-2-pentanone (MIBK	ug/L	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	ug/L	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
Benzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Bromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	ug/L	1 U	1 U	1 U	1 UJ	1 UJ	1 U
Carbon disulfide	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	ug/L	1 UJ	1 U	1 U	1 U	1 U	1 U
Chloroform	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Chloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U.
cis-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	ug/L	2 U	2 U	2 U	2 U	2 U	2 U
Styrene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	1 U	1 U	1 U	1 UJ	1 UJ	1 UJ
Toluene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethylene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Xylenes	ug/L	1 U	1 U	1 U	1 U	1 U	1 U

Data Qualifiers:
U Analyzed for but not detected.
J Estimated value.
R Result is rejected due to a defi
UJ Value obtained from a diluted
Bolded values indicate reported co

absence of the target analyte cannot be verified.

Table 2• Inorganic Data Summary
Baseline Groundwater Monitoring Report
Ionia City Landfill
June 1999

Well Number Comment Collection Date		MW-2 02/02/99	MW-4R 02/11/99	MW-5 02/02/99	MW-7R 02/09/99	MW-8 02/03/99	MW-8 Duplicate 02/03/99	MW-10R 02/08/99	MW-12 02/03/99	MW-13R 02/11/99
Parameter	Units									
Aluminum, Total	ug/L	973	292 U	14.8 U	21.6 U	9.7 U	3.7 U	3.7 U	11.7 B	16 U
Antimony, Total	ug/L	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U
Arsenic, Total	ug/L	6 B	9.8 B	2.7 U	5.2 B	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U
Barium, Total	ug/L	169 B	105 B	110 B	184 B	208	204	180 B	20.3 B	25.4 B
Beryllium, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium, Total	ug/L	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Chromium, Total	ug/L	6.5 B	7.6 U	1.1 B	0.9 U	2.8 B	0.81 U	1.3 U	1.7 B	1.1 U
Cobalt, Total	ug/L	1.4 B	2.2 B	0.8 U	0.8 U	0.8 U	0.8 U	1.3 B	0.8 U	0.8 U
Copper, Total	ug/L	4.2 B	1.7 U	3.5 B	0.99 U	14.5 B	1.5 U	1.3 U	2.3 B	59.5
Cyanide	ug/L	2.1 U	2.1 UJ	2.1 U	2.1 UJ	2.1 U	2.1 U	2.1 U	2.6 U	2.1 UJ
Iron, Total	ug/L	1510	9520	18.8 U	7820	1860	1610	700	2260	810 U
Lead, Total	ug/L	1.8 U	1.8 UJ	1.8 U	1.8 UJ	4.1	1.8 U	1.8 U	1.8 U	40.3 J
Manganese, Total	ug/L	138	454	10.9 B	578	1020	1000	1000	39.6	66.7
Mercury, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel, Total	ug/L	9.6 B	4.6 B	1.3 U	1.3 U	2.5 B	1.5 B	2.2 B	1.3 B	1.3 U
Selenium, Total	ug/L	3.2 U	3.2 U	21	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Silver, Total	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Thallium, Total	ug/L	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U
Vanadium, Total	ug/L	2.7 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Zinc, Total	ug/L	10.2 U	7.1 U	6.6 U	25.9 U	19.4 U	7.6 U	6 U	15.9 U	60.4

Data Qualifiers:
U Analyzed for but not detected.
J Estimated value.
B Value is less than the Contract Required Detection Limit but greater than the Instrument Detection Limit.

Table 2• Inorganic D
Baseline Groundwater I
Ionia City Landfill
June 1999

Well Number Comment Collection Date		MW-13R Duplicate 02/11/99	MW-14 02/15/99	MW-15 02/19/99	MW-16 02/10/99	MW-17 02/04/99	OW-21 02/16/99	OW-22 02/09/99	OW-23 02/08/99	OW-23 Duplicate 02/08/99
Parameter	Units									
Aluminum, Total	ug/L	21 U	30.5 U	13 U	10.1 U	1950	25.3 U	91.7 B	229 U	152 U
Antimony, Total	ug/L	3.7 U	3.7 U	3.8 B	3.7 U	3.7 U	4 B	3.7 U	3.7 U	3.7 U
Arsenic, Total	ug/L	2.8 B	2.7 U	2.7 U	2.7 U	3.1 B	2.7 U	3 B	23.1	20.8
Barium, Total	ug/L	25.9 B	46.4 B	75.4 B	49 B	30 B	105 B	34.8 B	64 B	63.3 B
Beryllium, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.12 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium, Total	ug/L	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	1.3 B	0.3 U	0.3 U	0.3 U
Chromium, Total	ug/L	0.8 U	1.7 U	0.9 U	0.89 U	28.7	0.91 B	1.4 U	4 U	4.1 U
Cobalt, Total	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	1.2 B	0.8 U	0.8 U	0.8 U	0.8 U
Copper, Total	ug/L	43	2.6 U	0.5 U	0.5 U	8.1 B	12.5 B	1 U	5 U	1.4 U
Cyanide	ug/L	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2.1 U	2.1 UJ	2.1 UJ	3 U	2.1 U
Iron, Total	ug/L	853 U	1480	429 U	23.1 U	2780	398	3130	8610	8580
Lead, Total	ug/L	28.9 J	1.8 UJ	1.8 UJ	1.8 UJ	1.8 U	1.8 U	1.8 UJ	2.9 B	1.8 U
Manganese, Tota	ug/L	66.5	257	211	180	81.8	45.6	50.6	231	231
Mercury, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel, Total	ug/L	1.3 U	1.3 U	1.3 U	1.3 U	12.2 B	25 B	1.3 U	6.6 B	6.2 B
Selenium, Total	ug/L	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	9.5	3.2 U	3.2 U	3.2 U
Silver, Total	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Thallium, Total	ug/L	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.8 U	4.7 U	4.7 U
Vanadium, Total	ug/L	1 U	1 U	1 U	1 U	4.6 U	1 U	1 U	1 U	1.7 U
Zinc, Total	ug/L	415	27.2	6.6 U	24.3 U	14.2 U	1200	27.2 U	42.5	39.9

Data Qualifiers:
U Analyzed for but n
J Estimated value.
B Value is less than th

Table 2• Inorganic D
Baseline Groundwater I
Ionia City Landfill
June 1999

Well Number Comment Collection Date		PMW-1 02/16/99	PMW-2 02/16/99	PMW-3 02/15/99	PMW-4 02/10/99	PMW-5 02/15/99	PZ-18D 02/09/99	PZ-18S 02/09/99	PZ-19D 02/08/99	PZ-19S 02/04/99
Parameter	Units									
Aluminum, Total	ug/L	180 U	160 U	15.6 U	310 U	62.2 U	19.1 U	5.5 U	40.6 U	365
Antimony, Total	ug/L	3.7 U	5.8 B	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U
Arsenic, Total	ug/L	2.7 U	2.7 U	2.9 B	3.2 B	2.7 U	18.9	2.7 U	19	9.1 B
Barium, Total	ug/L	63.8 B	47 B	83.3 B	34.7 B	117 B	258	206	24.9 B	66.3 B
Beryllium, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium, Total	ug/L	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Chromium, Total	ug/L	25.2	2070	2.5 U	246	5.4 U	1.4 U	1.7 U	1.7 U	20.4
Cobalt, Total	ug/L	0.89 B	3.7 B	0.8 U	5.5 B	0.8 U	0.8 U	2.2 B	0.8 U	1.2 B
Copper, Total	ug/L	4.1 B	394	4.1 U	4.9 U	68.6	0.92 U	2.5 U	0.63 U	2.3 U
Cyanide	ug/L	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2.1 U	2.1 U
Iron, Total	ug/L	350	1110	364 U	2150	171	14600	137 U	1890	7040
Lead, Total	ug/L	1.8 U	129	1.8 UJ	1.8 UJ	30 J	1.8 UJ	1.8 UJ	1.8 U	1.8 U
Manganese, Tota	ug/L	440	149	9.2 U	251	8.9 U	190	649	61.9	362
Mercury, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel, Total	ug/L	39.2 B	110	2.6 B	690	12 B	1.3 U	6.6 B	1.9 B	15.4 B
Selenium, Total	ug/L	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Silver, Total	ug/L	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Thallium, Total	ug/L	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U
Vanadium, Total	ug/L	1 U	10.8 B	1 U	1 U	1 U	1 U	1 U	1 U	3.3 U
Zinc, Total	ug/L	100	259	43.1	96.4	100	23.5 U	154	4.1 U	27.8 U

Data Qualifiers:
U Analyzed for but n•
J Estimated value.
B Value is less than tl

Table 2• Inorganic D
Baseline Groundwater I
Ionia City Landfill
June 1999

Well Number Comment Collection Date		PZ-20D 02/11/99	PZ-21D 02/16/99	PZ-21S 02/16/99	PZ-22D 02/08/99	PZ-23 02/08/99	Field Blank #1 02/03/99	Field Blank #2 02/08/99	Field Blank #3 02/09/99	Field Blank #4 02/15/99
Parameter	Units									
Aluminum, Total	ug/L	11.3 U	25 U	34.1 U	6 U	922	3.7 U	3.7 U	111 B	16.6 U
Antimony, Total	ug/L	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U
Arsenic, Total	ug/L	13.9	10.9	37.6	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U
Barium, Total	ug/L	20.8 B	49.6 B	87.2 B	24.3 B	34.2 B	0.2 U	0.2 U	1.4 U	0.2 U
Beryllium, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium, Total	ug/L	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Chromium, Total	ug/L	1.9 U	9.1 B	1.9 B	1.9 U	87.1	0.96 U	1.8 U	2.1 U	0.96 U
Cobalt, Total	ug/L	0.8 U	0.8 U	2.4 B	0.8 U	10.2 B	0.8 U	0.8 U	0.8 U	0.8 U
Copper, Total	ug/L	45.1	0.78 U	43	0.5 U	4.8 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyanide	ug/L	10.3 J	2.1 UJ	2.1 UJ	2.1 U	2.1 U	2.4 B	2.1 U	2.1 UJ	2.1 UJ
Iron, Total	ug/L	5380	7170	10900	1640	4530	18.8 U	22 U	185	18.8 U
Lead, Total	ug/L	23.1 J	1.8 U	13.1	1.8 U	1.8 U	1.8 U	1.8 U	1.8 UJ	1.8 UJ
Manganese, Tota	ug/L	82.8	238	1040	31.8	357	0.2 U	0.45 U	8.5 U	0.2 U
Mercury, Total	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel, Total	ug/L	1.5 B	5.7 B	1.3 U	1.3 B	784	1.3 U	1.3 U	1.3 U	1.3 U
Selenium, Total	ug/L	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Silver, Total	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 B
Thallium, Total	ug/L	4.7 U	5 B	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U
Vanadium, Total	ug/L	1 U	1 U	1 U	1 U	1.7 U	1 U	1 U	1 U	1 U
Zinc, Total	ug/L	84.6	98	30	23.3 U	46.4	4.3 B	7.8 B	5.3 B	3 B

Data Qualifiers:
U Analyzed for but n
J Estimated value.
B Value is less than th

Risk Tables

HUMAN HEALTH RISK TABLE 1
SUMMARY OF RISK FOR A GENERAL WORKER
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Oral	Area B Soil Inhalation	Dermal	Sediment Dermal	Air (1987 Data) Inhalation	Air (Air Stripper Data) Inhalation	Chemical-Specific Subtotal	% of Total
MLE Risk Estimates								
Arsenic	6.6E-07	6.8E-10	6.2E-08	4.6E-08			7.7E-07	81.6%
Benzene						1.2E-10	1.2E-10	0.0%
Benzo(a)Pyrene				4.9E-08			4.9E-08	5.2%
Cadmium		1.4E-11					1.4E-11	0.0%
Dichloroethene, 1,1-						6.8E-10	6.8E-10	0.1%
Methylene Chloride	7.5E-12	1.6E-16	1.7E-11	4.1E-12			2.9E-11	0.0%
Trichloroethene						9.3E-11	9.3E-11	0.0%
Vinyl Chloride						1.2E-07	1.2E-07	13.1%
Pathway-Specific Subtotal	6.6E-07	6.9E-10	6.2E-08	9.5E-08		1.2E-07	9E-07	100.0%
% of Total	70.1%	0.1%	6.5%	10.1%		13.2%	100.0%	
RME Risk Estimates								
Arsenic	8.25E-06	8.45989E-09	7.68E-07	8.39034E-07			9.9E-06	90.3%
Benzene						7.0E-10	7.0E-10	0.0%
Benzo(a)Pyrene				3.2E-07			3.2E-07	2.9%
Cadmium		4.4E-10					4.4E-10	0.0%
Dichloroethene, 1,1-						4.1E-09	4.1E-09	0.0%
Methylene Chloride	6.7E-11	1.5E-15	1.5E-10	4.2E-11			2.6E-10	0.0%
Trichloroethene						5.5E-10	5.5E-10	0.0%
Vinyl Chloride						7.3E-07	7.3E-07	6.7%
Pathway-Specific Subtotal	8.2E-06	8.9E-09	7.7E-07	1.2E-06		7.4E-07	1E-05	100.0%
% of Total	75.5%	0.1%	7.0%	10.6%		6.8%	100.0%	

HUMAN HEALTH RISK TABLE 2
SUMMARY OF RISK FOR AN EXCAVATION WORKER
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Oral	Area B Soil Inhalation	Dermal	Air (1987 Data) Inhalation	Air (Air Stripper Data) Inhalation	Chemical-Specific Subtotal	% of Total
MLE Risk Estimates							
Arsenic	1.8161E-07	2.03417E-10	1.7605E-09			1.8E-07	98.1%
Benzene					3.4E-12	3.4E-12	0.0%
Cadmium		4.2E-12				4.2E-12	0.0%
Dichloroethene, 1,1-					2.0E-11	2.0E-11	0.0%
Methylene Chloride	2.0E-12	4.9E-17	4.9E-13			2.5E-12	0.0%
Trichloroethene					2.6E-12	2.6E-12	0.0%
Vinyl Chloride					3.5E-09	3.5E-09	1.9%
Pathway-Specific Subtotal	1.8E-07	2.1E-10	1.8E-09		3.6E-09	2E-07	100.0%
% of Total	97.0%	0.1%	0.9%		1.9%	100.0%	
RME Risk Estimates							
Arsenic	3.8009E-07	4.25723E-10	3.6845E-09			3.8E-07	99.1%
Benzene					3.4E-12	3.4E-12	0.0%
Cadmium		2.2E-11				2.2E-11	0.0%
Dichloroethene, 1,1-					2.0E-11	2.0E-11	0.0%
Methylene Chloride	3.1E-12	7.4E-17	7.4E-13			3.8E-12	0.0%
Trichloroethene					2.6E-12	2.6E-12	0.0%
Vinyl Chloride					3.5E-09	3.5E-09	0.9%
Pathway-Specific Subtotal	3.8E-07	4.5E-10	3.7E-09		3.6E-09	4E-07	100.0%
% of Total	98.0%	0.1%	1.0%		0.9%	100.0%	

HUMAN HEALTH RISK TABLE 3
SUMMARY OF RISK FOR A RESIDENT ADULT
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Soil		Sediment	Surface Water		Air (1987 Data)	Air (Air Stripper Data)		Chemical-Specific	% of
	Oral	Inhalation	Dermal	Dermal	Oral	Dermal	Inhalation	On-Site Inhalation	Off-Site Inhalation	Subtotal	Total
MLE Risk Estimates											
Arsenic	4.9E-07	3.14146E-11	2.28E-08	1.96685E-08	7.17E-08	8.342E-09				6.1E-07	41.3%
Benzene					1.1E-09	1.4E-08		4.4E-11	7.1E-10	1.6E-08	1.1%
Benzo(a)Pyrene	2.2E-08	1.2E-13	1.0E-08	2.1E-08						5.3E-08	3.6%
Cadmium		2.0E-12								2.0E-12	0.0%
Dichloroethene, 1,1-								2.6E-10	4.1E-09	4.4E-09	0.3%
Dichloropropene, Cis-1,3-					6.8E-09					6.8E-09	0.5%
Methylene Chloride	1.6E-12	2.1E-18	1.8E-12	1.8E-12	2.7E-10	1.4E-10				4.2E-10	0.0%
N-Nitrosodiphenylamine					5.2E-10	1.2E-09				1.7E-09	0.1%
Trichloroethene								3.5E-11	5.6E-10	5.9E-10	0.0%
Vinyl Chloride								4.6E-08	7.4E-07	7.9E-07	53.1%
Pathway-Specific Subtotal	5.1E-07	3.4E-11	3.3E-08	4.1E-08	8.0E-08	2.3E-08		4.7E-08	7.5E-07	1E-06	100.0%
% of Total	34.5%	0.0%	2.2%	2.8%	5.4%	1.6%		3.1%	50.3%	100.0%	
RME Risk Estimates											
Arsenic	4.22E-06	5.40548E-10	1.962E-07	4.02736E-07	9.56E-07	1.112E-07				5.9E-06	62.6%
Benzene					1.5E-08	1.8E-07		2.9E-10	2.4E-09	2.0E-07	2.1%
Benzo(a)Pyrene	1.5E-07	1.6E-12	6.7E-08	1.5E-07						3.7E-07	3.9%
Cadmium		3.2E-11								3.2E-11	0.0%
Dichloroethene, 1,1-								1.7E-09	1.4E-08	1.5E-08	0.2%
Dichloropropene, Cis-1,3-					9.1E-08					9.1E-08	1.0%
Methylene Chloride	2.1E-11	5.7E-17	2.4E-11	2.0E-11	3.8E-09	1.9E-09				5.8E-09	0.1%
N-Nitrosodiphenylamine					1.8E-08	4.1E-08				5.8E-08	0.6%
Trichloroethene								2.3E-10	1.9E-09	2.1E-09	0.0%
Vinyl Chloride								3.1E-07	2.5E-06	2.8E-06	29.5%
Pathway-Specific Subtotal	4.4E-06	5.7E-10	2.6E-07	5.6E-07	1.1E-06	3.4E-07		3.1E-07	2.5E-06	9E-06	100.0%
% of Total	46.4%	0.0%	2.8%	5.9%	11.5%	3.6%		3.3%	26.5%	100.0%	

HUMAN HEALTH RISK TABLE 4

EXPOSURE POINT CONCENTRATIONS FOR COIs IN AIR (AIR STRIPPER DATA)[a]
IONIA CITY LANDFILL

Chemical	Exposure Point Concentration (mg/m3)	
	On-Site	Off-Site
Benzene	1.1E-06	3.5E-07
Chloroethane	4.7E-06	1.5E-06
Dichloroethane, 1,1-	2.9E-05	9.1E-06
Dichloroethene, 1,1-	1.0E-06	3.2E-07
Dichloroethene, cis-1,2-	7.0E-05	2.2E-05
Dichloroethene, trans-1,2-	1.1E-06	3.3E-07
Trichloroethane, 1,1,1-	9.2E-07	2.9E-07
Trichloroethene	3.9E-06	1.3E-06
Vinyl Chloride	1.1E-04	3.3E-05

a Derived using Michigan Department of Environmental Quality methodology (see Appendix B).

HUMAN HEALTH RISK TABLE 5
SUMMARY OF RISK FOR ADULT FISH INGESTION
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Fish Oral	Chemical-Specific Subtotal	% of Total
MLE Risk Estimates			
Arsenic	8.784E-07	8.8E-07	45.8%
Benzene	9.2E-08	9.2E-08	4.8%
Dichloropropene, Cis-1,3-	5.5E-07	5.5E-07	28.5%
Methylene Chloride	4.8E-09	4.8E-09	0.2%
N-Nitrosodiphenylamine	4.0E-07	4.0E-07	20.7%
Pathway-Specific Subtotal	1.9E-06	2E-06	100.0%
RME Risk Estimates			
Arsenic	2.928E-06	2.9E-06	34.7%
Benzene	3.1E-07	3.1E-07	3.6%
Dichloropropene, Cis-1,3-	1.8E-06	1.8E-06	21.6%
Methylene Chloride	1.7E-08	1.7E-08	0.2%
N-Nitrosodiphenylamine	3.4E-06	3.4E-06	40.0%
Pathway-Specific Subtotal	8.5E-06	8E-06	100.0%

HUMAN HEALTH RISK TABLE 6
SUMMARY OF HIs FOR GENERAL WORKER
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Area B Soil			Sediment	Air (1987 Data)	Air (Air Stripper Data)	Chemical-Specific	% of
	Oral	Inhalation	Dermal	Dermal	Inhalation	Inhalation	Subtotal	Total
MLE HI Estimates								
Aluminum	7.00E-03	7.18E-07	6.38E-04	2.80E-04			7.92E-03	4.0%
Antimony				4.50E-03			4.50E-03	2.3%
Arsenic	2.45E-02	2.52E-06	2.28E-03	1.70E-03			2.85E-02	14.5%
Barium	2.10E-03	1.08E-05	1.91E-03				4.02E-03	2.0%
Benzene						4.24E-05	4.24E-05	0.0%
Benzo(a)Pyrene				3.76E-07			3.76E-07	0.0%
Butyl Benzyl Phthalate				3.79E-08			3.79E-08	0.0%
Cadmium	3.62E-04	7.42E-08	1.32E-03	3.00E-03			4.69E-03	2.4%
Chloroethane						1.06E-07	1.06E-07	0.0%
Chromium	1.27E-05	4.99E-08	1.15E-04	6.49E-05			1.93E-04	0.1%
Dichloroethane, 1,1-	2.11E-09	2.16E-13	4.81E-09	2.23E-09		1.87E-06	1.88E-06	0.0%
Dichloroethene, 1,1-						7.24E-06	7.24E-06	0.0%
Dichloroethene, cis-1,2-						4.56E-05	4.56E-05	0.0%
Dichloroethene, trans-1,2-	7.34E-09	7.53E-13	1.67E-08	1.12E-08		3.43E-07	3.78E-07	0.0%
Iron	5.00E-02	5.13E-06	4.56E-02	3.26E-02			1.28E-01	65.0%
Manganese	1.06E-02	3.64E-03					1.42E-02	7.2%
Methylene Chloride	2.76E-07	1.98E-12	6.30E-07	1.53E-07			1.06E-06	0.0%
Selenium				5.54E-06			5.54E-06	0.0%
Silver				2.63E-05			2.63E-05	0.0%
Trichloroethane, 1,1,1-					2.68E-04	2.07E-07	2.68E-04	0.1%
Trichloroethene						8.30E-08	8.30E-08	0.0%
Vinyl Chloride						4.57E-03	4.57E-03	2.3%
Pathway-Specific Subtotal	9.5E-02	3.7E-03	5.2E-02	4.2E-02	2.7E-04	4.7E-03	2E-01	100.0%
% of Total	47.9%	1.9%	26.3%	21.4%	0.1%	2.4%	100.0%	
RME HI Estimates								
Aluminum	8.61E-03	8.83E-07	7.85E-04	5.67E-04			1.0E-02	3.1%
Antimony				4.91E-03			4.9E-03	1.5%
Arsenic	5.13E-02	5.26E-06	4.78E-03	5.22E-03			6.1E-02	19.0%
Barium	3.53E-03	1.81E-04	3.22E-03				6.9E-03	2.1%
Benzene						4.2E-05	4.2E-05	0.0%
Benzo(a)Pyrene				4.11E-06			4.1E-06	0.0%
Butyl Benzyl Phthalate				3.8E-07			3.8E-07	0.0%
Cadmium	1.9E-03	3.9E-07	7.0E-03	3.8E-03			1.3E-02	3.9%
Chloroethane						1.1E-07	1.1E-07	0.0%
Chromium	1.5E-05	5.8E-08	1.3E-04	7.7E-05			2.3E-04	0.1%
Dichloroethane, 1,1-	2.4E-08	2.4E-12	5.4E-08	2.2E-08		1.9E-05	1.9E-05	0.0%
Dichloroethene, 1,1-						7.2E-06	7.2E-06	0.0%
Dichloroethene, cis-1,2-						4.6E-04	4.6E-04	0.1%
Dichloroethene, trans-1,2-	7.3E-08	7.5E-12	1.7E-07	1.1E-07		3.4E-06	3.8E-06	0.0%
Iron	6.4E-02	6.6E-06	5.8E-02	7.8E-02			2.0E-01	62.0%
Manganese	1.6E-02	5.4E-03					2.1E-02	6.6%
Methylene Chloride	4.2E-07	3.0E-12	9.5E-07	2.6E-07			1.6E-06	0.0%
Selenium				7.0E-06			7.0E-06	0.0%
Silver				4.2E-05			4.2E-05	0.0%
Trichloroethane, 1,1,1-					4.3E-04	2.1E-07	4.3E-04	0.1%
Trichloroethene						8.3E-08	8.3E-08	0.0%
Vinyl Chloride						4.6E-03	4.6E-03	1.4%
Pathway-Specific Subtotal	1.5E-01	5.6E-03	7.4E-02	9.2E-02	4.3E-04	5.1E-03	3E-01	100.0%
% of Total	45.0%	1.7%	23.0%	28.6%	0.1%	1.6%	100.0%	

NA Not applicable

HUMAN HEALTH RISK TABLE 7
SUMMARY OF HIs FOR AN EXCAVATION WORKER
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Area B Soil Oral	Area B Soil Inhalation	Area B Soil Dermal	Air (1987 Data) Inhalation	Air (Air Stripper Data) Inhalation	Chemical-Specific Subtotal	% of Total
MLE HI Estimates							
Aluminum	9.81E-02	1.10E-05	9.32E-04			9.9E-02	6.8%
Arsenic	3.44E-01	3.85E-05	3.33E-03			3.5E-01	23.7%
Barium	2.94E-02	1.65E-04	2.79E-03			3.2E-02	2.2%
Benzene					6.2E-05	6.2E-05	0.0%
Cadmium	5.1E-03	1.1E-06	1.9E-03			7.0E-03	0.5%
Chloroethane					1.6E-07	1.6E-07	0.0%
Chromium	1.8E-04	7.6E-07	1.7E-04			3.5E-04	0.0%
Dichloroethane, 1,1-	3.0E-08	3.3E-12	7.0E-09		2.7E-06	2.8E-06	0.0%
Dichloroethene, 1,1-					1.1E-05	1.1E-05	0.0%
Dichloroethene, cis-1,2-					6.7E-05	6.7E-05	0.0%
Dichloroethene, Trans-1,2-	1.0E-07	1.2E-11	2.4E-08		5.0E-07	6.3E-07	0.0%
Iron	7.0E-01	7.9E-05	6.7E-02			7.7E-01	52.4%
Manganese	1.5E-01	5.6E-02				2.0E-01	13.9%
Methylene Chloride	3.9E-06	3.0E-11	9.2E-07			4.8E-06	0.0%
Trichloroethane, 1,1,1-				3.9E-04	3.0E-07	3.9E-04	0.0%
Trichloroethene					1.2E-07	1.2E-07	0.0%
Vinyl Chloride					6.7E-03	6.7E-03	0.5%
Pathway-Specific Subtotal	1.3E+00	5.6E-02	7.6E-02	3.9E-04	6.8E-03	**1E+00**	100.0%
% of Total	90.5%	3.8%	5.2%	0.0%	0.5%	100.0%	
RME HI Estimates							
Aluminum	1.21E-01	1.35E-05	1.15E-03			1.2E-01	5.5%
Arsenic	7.19E-01	8.06E-05	6.97E-03			7.3E-01	32.5%
Barium	4.94E-02	2.77E-04	4.69E-03			5.4E-02	2.4%
Benzene					6.2E-05	6.2E-05	0.0%
Cadmium	2.7E-02	6.0E-06	1.0E-02			3.7E-02	1.7%
Chloroethane					1.6E-07	1.6E-07	0.0%
Chromium	2.1E-04	8.9E-07	2.0E-04			4.0E-04	0.0%
Dichloroethane, 1,1-	3.3E-08	3.7E-12	7.9E-09		2.7E-06	2.8E-06	0.0%
Dichloroethene, 1,1-					1.1E-05	1.1E-05	0.0%
Dichloroethene, cis-1,2-					6.7E-05	6.7E-05	0.0%
Dichloroethene, Trans-1,2-	1.0E-07	1.2E-11	2.4E-08		5.0E-07	6.3E-07	0.0%
Iron	9.0E-01	1.0E-04	8.5E-02			9.8E-01	44.0%
Manganese	2.2E-01	8.3E-02				3.0E-01	13.6%
Methylene Chloride	5.9E-06	4.6E-11	1.4E-06			7.2E-06	0.0%
Trichloroethane, 1,1,1-				6.3E-04	3.0E-07	6.3E-04	0.0%
Trichloroethene					1.2E-07	1.2E-07	0.0%
Vinyl Chloride					6.7E-03	6.7E-03	0.3%
Pathway-Specific Subtotal	2.0E+00	8.4E-02	1.1E-01	6.3E-04	6.8E-03	**2E+00**	100.0%
% of Total	91.1%	3.7%	4.9%	0.0%	0.3%	100.0%	

NA Not applicable.

HUMAN HEALTH RISK TABLE 8
SUMMARY OF HIs FOR A RESIDENT ADULT
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Soil			Sediment	Surface Water		Air (1987 Data)	Air (Air Stripper Data)		Chemical-Specific	% of
	Oral	Inhalation	Dermal	Dermal	Oral	Dermal	Inhalation	On-Site Inhalation	Off-Site Inhalation	Subtotal	Total
MLE HI Estimates											
Aluminum	1 50E-03	9 59E-09	6 82E-05	5.60E-05						1 62E-03	1 9%
Antimony				9 00E-04	3 18E-03	3 63E-03				7 70E-03	9 2%
Arsenic	8 47E-03	5 43E-08	3 94E-04	3 40E-04	1 24E-03	1 44E-04				1 06E-02	12 6%
Barium	2 76E-04	8 83E-07	1 26E-04							4 02E-04	0 5%
Benzene					9 78E-04	1 23E-02		7 41E-06	1 19E-04	1 34E-02	15 9%
Benzo(a)Pyrene	7 83E-07	5 02E-12	3 57E-07	7 51E-07						1 89E-06	0 0%
Butyl Benzyl Phthalate	1 33E-07	8 50E-13	6 05E-08	7 59E-08						2 69E-07	0 0%
Cadmium	3 89E-04	4 99E-09	7 10E-04	6 01E-04	7 36E-04	3 36E-03				5 79E-03	6 9%
Chloroethane								1 86E-08	2 98E-07	3 17E-07	0 0%
Chromium	2 47E-06	6 08E-10	1 13E-05	1 30E-05						2 67E-05	0 0%
Dichloroethane, 1,1-				4.46E-09	1 96E-06	1 99E-06		3.27E-06	5.23E-05	5 95E-05	0 1%
Dichloroethene, 1,1-								1 27E-06	2 03E-05	2 15E-05	0 0%
Dichloroethene, cis-1,2-								7 98E-05	1 28E-03	1 36E-03	1 6%
Dichloroethene, trans-1,2-	9.8E-09	6.3E-14	1.1E-08	2.2E-08	1 47E-05	2.37E-05		6.00E-07	9.60E-06	4 86E-05	0 1%
Dichloropropene, Cis-1,3-					9 78E-04					9 78E-04	1 2%
Iron	1 18E-02	7 58E-08	5 39E-03	6.52E-03						2 37E-02	28 2%
Manganese	3 06E-03	6.58E-05			2 71E-04					3.39E-03	4 0%
Methylene Chloride	2 70E-08	1 21E-14	3 07E-08	3 05E-08	4.73E-06	2.43E-06				7 24E-06	0 0%
N-Nitrosodiphenylamine					4.16E-05	9.48E-05				1.36E-04	0.2%
Selenium	4 51E-05	2 89E-10	2 57E-06	1.11E-06						4 88E-05	0 1%
Silver	1 68E-05	1 89E-07	3 66E-06	5.26E-06						2.59E-05	0 0%
Trichloroethane, 1,1,1-							1.12E-03	3 62E-08	5.79E-07	1 12E-03	1 3%
Trichloroethene								1 45E-08	2 32E-07	2 47E-07	0 0%
Vinyl Chloride								8.00E-04	1.28E-02	1 36E-02	16 2%
Pathway-Specific Subtotal	2 6E-02	6.7E-05	6.7E-03	8 4E-03	7 4E-03	2 0E-02	1.1E-03	8.9E-04	1 4E-02	8E-02	100 0%
% of Total	30.4%	0 1%	8.0%	10.0%	8.9%	23.2%	1.3%	1.1%	17.0%	100.0%	
RME HI Estimates											
Aluminum	3 73E-03	4.78E-08	1.70E-04	2.27E-04						4 13E-03	2 0%
Antimony				1.96E-03	1 75E-02	1.99E-02				3.93E-02	19 5%
Arsenic	2 19E-02	2.80E-07	1.02E-03	2.09E-03	4 96E-03	5.77E-04				3 05E-02	15 1%
Barium	1 16E-03	7 43E-06	5.28E-04							1 69E-03	0 8%
Benzene					3.91E-03	4.91E-02		1 48E-05	1 19E-04	5.31E-02	26 3%
Benzo(a)Pyrene	1 57E-06	2.01E-11	7 14E-07	1 64E-06						3 92E-06	0 0%
Butyl Benzyl Phthalate	3 62E-07	4 64E-12	1 65E-07	1.52E-07						6.79E-07	0 0%
Cadmium	9 14E-04	2.34E-08	1.67E-03	1.54E-03	5.02E-03	2.29E-02				3 20E-02	15 9%
Chloroethane								3.72E-08	2 98E-07	3 35E-07	0 0%
Chromium	5 89E-06	2.91E-09	2 69E-05	3.09E-05						6 36E-05	0 0%
Dichloroethane, 1,1-				8.92E-09	7.83E-06	7.94E-06		6 54E-06	5 23E-05	7.46E-05	0 0%
Dichloroethene, 1,1-								2 53E-06	2.03E-05	2 28E-05	0 0%
Dichloroethene, cis-1,2-								1.60E-04	1 28E-03	1 44E-03	0 7%
Dichloroethene, trans-1,2-	1 96E-08	2 51E-13	2.23E-08	4 46E-08	5 87E-05	9.47E-05		1 20E-06	9 60E-06	1 64E-04	0 1%
Dichloropropene, Cis-1,3-					3 91E-03						
Iron	3 09E-02	3 96E-07	1 41E-02	3 11E-02						2.25E-02	11 2%
Manganese	1 40E-02	6 02E-04			7 94E-03					2 99E-05	0 0%
Methylene Chloride	1 09E-07	9 75E-14	1.24E-07	1 04E-07	1 96E-05	1.00E-05					
N-Nitrosodiphenylamine					4 23E-04	9 65E-05				1 80E-04	0 1%
Selenium	1 68E-04	2 15E-09	9.57E-06	2 81E-06						7 82E-05	0 0%
Silver	4 94E-05	1 11E-06	1 07E-05	1.69E-05						1 82E-03	0 9%
Trichloroethane, 1,1,1-							1 82E-03	7 24E-08	5 79E-07	2 61E-07	0 0%
Trichloroethene								2 90E-08	2 32E-07	1 44E-02	7 1%
Vinyl Chloride								1 60E-03	1 28E-02		
Pathway-Specific Subtotal	7 3E-02	6 1E-04	1 8E-02	3 7E-02	4 4E-02	9 4E-02	1 8E-03	1 8E-03	1 4E-02	2E-01	100 0%

NA Not applicable

HUMAN HEALTH RISK TABLE 9
SUMMARY OF HIs FOR A RESIDENT CHILD
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Soil			Sediment	Surface Water		Air (1987 Data)	Air (Air Stripper Data)		Chemical-Specific	% of
	Oral	Inhalation	Dermal	Dermal	Oral	Dermal	Inhalation	On-Site Inhalation	Off-Site Inhalation	Subtotal	Total
MLE HI Estimates											
Aluminum	1 40E-02	2 24E-08	6 07E-04	4 99E-04						1 51E-02	3 1%
Antimony				8 01E-03	1.5E-02	8.6E-03				3.15E-02	6 5%
Arsenic	7 91E-02	1 27E-07	3 51E-03	3.03E-03	5.8E-03	3.4E-04				9 17E-02	18 9%
Barium	2 57E-03	2 06E-07	1 12E-03							3 69E-03	0 8%
Benzene					4.6E-03	2.9E-02		1 73E-05	2 77E-04	3 40E-02	7 0%
Benzo(a)Pyrene	7 31E-07	1 17E-12	3 18E-07	6 69E-07						1 72E-06	0 0%
Butyl Benzyl Phthalate	1 24E-07	1 98E-13	5 38E-08	6 75E-08						2 45E-07	0 0%
Cadmium	3 63E-03	1 16E-08	6 32E-03	5 35E-03	3.4E-03	8.0E-03				2 67E-02	5 5%
Chloroethane								4 35E-08	6 95E-07	7 39E-07	0 0%
Chromium	2 30E-05	1 42E-09	1 00E-04	1 15E-04						2 39E-04	0 0%
Dichloroethane, 1,1-				3 97E-09	9 13E-07	4 71E-07		7 63E-07	1 22E-05	1 44E-05	0 0%
Dichloroethene, 1,1-								2 96E-06	4 73E-05	5 03E-05	0 0%
Dichloroethene, cis-1,2-					6 85E-06	5 62E-06		1 86E-05	2 98E-04	3 29E-04	0 1%
Dichloroethene, trans-1,2-	9 13E-09	1 46E-14	9 93E-09	1 99E-08	4 57E-04			1 40E-07	2 24E-06	4 59E-04	0 1%
Dichloropropene, Cis-1,3-											
Iron	1 10E-01	1 77E-07	4 80E-02	5 81E-02						2.16E-01	44 6%
Manganese	2 85E-02	1 53E-04			1 26E-03					2 99E-02	6 2%
Methylene Chloride	2 52E-07	2 81E-14	2 74E-07	2 72E-07	2 21E-05	5 76E-06				2 86E-05	0 0%
N-Nitrosodiphenylamine					1 94E-04	2 25E-04				4 19E-04	0 1%
Selenium	4 21E-04	6 75E-10	2 29E-05	9 86E-06						4 54E-04	0 1%
Silver	1 57E-04	4 40E-07	3 26E-05	4 68E-05						2 37E-04	0 0%
Trichloroethane, 1,1,1-							2.62E-03	8 45E-08	1 35E-06	2 62E-03	0 5%
Trichloroethene								3 39E-08	5 42E-07	5 76E-07	0 0%
Vinyl Chloride								1 87E-03	2 99E-02	3 17E-02	6 5%
Pathway-Specific Subtotal	2 4E-01	1 5E-04	6 0E-02	7 5E-02	3 1E-02	4 6E-02	2.6E-03	1 9E-03	3 1E-02	**5E-01**	100 0%
% of Total	49 2%	0 0%	12 3%	15.5%	6.3%	9.5%	0 5%	0 4%	6 3%	100 0%	
RME HI Estimates											
Aluminum	3 48E-02	1 12E-07	1 51E-03	2 02E-03						3 8E-02	2 4%
Antimony				1.75E-02	8.15E-02	4.72E-02				1.5E-01	9 1%
Arsenic	2 04E-01	6 54E-07	9 06E-03	1 86E-02	2 31E-02	1.37E-03				2.6E-01	15 9%
Barium	1 08E-02	1 73E-06	4.70E-03							1.6E-02	1 0%
Benzene					1 83E-02	1.17E-01		3 46E-05	2 77E-04	1 4E-01	8 4%
Benzo(a)Pyrene	1 46E-06	4 68E-12	6 36E-07	1 46E-06						3 6E-06	0 0%
Butyl Benzyl Phthalate	3 38E-07	1 08E-12	1 47E-07	1 35E-07						6 2E-07	0 0%
Cadmium	8 53E-03	5 47E-08	1 48E-02	1 37E-02	2.34E-02	5.44E-02				1 1E-01	7 1%
Chloroethane								8 69E-08	6.95E-07	7 8E-07	0 0%
Chromium	5 50E-05	6 78E-09	2 39E-04	2 75E-04						5.7E-04	0 0%
Dichloroethane, 1,1-				7 95E-09	3 65E-06	1 89E-06		1 53E-06	1 22E-05	1 9E-05	0 0%
Dichloroethene, 1,1-								5 91E-06	4 73E-05	5 3E-05	0 0%
Dichloroethene, cis-1,2-					2 74E-05	2 25E-05		3 72E-05	2 98E-04	3 9E-04	0 0%
Dichloroethene, trans-1,2-	1 83E-08	5 85E-14	1 99E-08	3 97E-08	1 83E-03			2 80E-07	2 24E-06	1 8E-03	0 1%
Dichloropropene, Cis-1,3-											
Iron	2 88E-01	9 24E-07	1 25E-01	2 76E-01						6 9E-01	42 8%
Manganese	1 31E-01	1 41E-03			3 70E-02					1 7E-01	10 5%
Methylene Chloride	1 02E-06	2 27E-13	1 11E-06	9 27E-07	9 13E-05	2 38E-05				1 2E-04	0 0%
N-Nitrosodiphenylamine					1 98E-03	2.29E-03				4 3E-03	0 3%
Selenium	1 57E-03	5 02E-09	8 52E-05	2 50E-05						1 7E-03	0 1%
Silver	4 61E-04	2 58E-06	9 56E-05	1 51E-04						7 1E-04	0 0%
Trichloroethane, 1,1,1-							4 25E-03	1 69E-07	1 35E-06	4 3E-03	0 3%
Trichloroethene								6 78E-08	5 42E-07	6 1E-07	0 0%
Vinyl Chloride								3 73E-03	2 99E-02	3 4E-02	2 1%
Pathway-Specific Subtotal	6 8E-01	1 4E-03	1 6E-01	3 3E-01	1 9E-01	2 2E-01	4.3E-03	3 8E-03	3 1E-02	**2E+00**	100 0%
% of Total	42 1%	0 1%	9 7%	20 4%	11 6%	13 8%	0 3%	0 2%	1 9%	100 0%	

NA Not applicable

HUMAN HEALTH RISK TABLE 10
SUMMARY OF HIs FOR ADULT FISH INGESTION
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Fish Oral	Chemical-Specific Subtotal	% of Total
MLE HI Estimates			
Arsenic	1.52E-02	1.52E-02	2.1%
Benzene	8.22E-02	8.22E-02	11.4%
Cadmium	4.07E-01	4.07E-01	56.5%
Dichloroethane, 1,1-	6.85E-05	6.85E-05	0.0%
Dichloroethene, trans-1,2-	8.73E-04	8.73E-04	0.1%
Dichloropropene, Cis-1,3-	7.88E-02	7.88E-02	10.9%
Manganese	1.04E-01	1.04E-01	14.5%
Methylene Chloride	8.28E-05	8.28E-05	0.0%
N-Nitrosodiphenylamine	3.16E-02	3.16E-02	4.4%
Pathway-Specific Subtotal	7.2E-01	7E-01	100.0%
RME HI Estimates			
Arsenic	1.52E-02	1.52E-02	0.9%
Benzene	8.22E-02	8.22E-02	4.8%
Cadmium	6.94E-01	6.94E-01	40.5%
Dichloroethane, 1,1-	6.85E-05	6.85E-05	0.0%
Dichloroethene, trans-1,2-	8.73E-04	8.73E-04	0.1%
Dichloropropene, Cis-1,3-	7.88E-02	7.88E-02	4.6%
Manganese	7.64E-01	7.64E-01	44.5%
Methylene Chloride	8.56E-05	8.56E-05	0.0%
N-Nitrosodiphenylamine	8.04E-02	8.04E-02	4.7%
Pathway-Specific Subtotal	1.7E+00	2E+00	100.0%

NA Not applicable.

HUMAN HEALTH RISK TABLE 11
SUMMARY OF HIs FOR CHILD FISH INGESTION
IONIA CITY LANDFILL
(Page 1 of 1)

Chemical	Fish Oral	Chemical-Specific Subtotal	% of Total
MLE HI Estimates			
Arsenic	3.54E-02	3.54E-02	2.3%
Benzene	1.92E-01	1.92E-01	12.7%
Cadmium	9.49E-01	9.49E-01	62.8%
Dichloroethane, 1,1-	1.60E-05	1.60E-05	0.0%
Dichloroethene, trans-1,2-	2.04E-04	2.04E-04	0.0%
Dichloropropene, Cis-1,3-	1.84E-02	1.84E-02	1.2%
Manganese	2.43E-01	2.43E-01	16.1%
Methylene Chloride	1.93E-04	1.93E-04	0.0%
N-Nitrosodiphenylamine	7.37E-02	7.37E-02	4.9%
Pathway-Specific Subtotal	1.5E+00	2E+00	
RME HI Estimates			
Antimony	0.00E+00	0.0E+00	0.0%
Arsenic	3.54E-02	3.5E-02	0.9%
Benzene	1.92E-01	1.9E-01	5.0%
Cadmium	1.62E+00	1.6E+00	42.2%
Dichloroethane, 1,1-	1.60E-05	1.6E-05	0.0%
Dichloroethene, trans-1,2-	2.04E-04	2.0E-04	0.0%
Dichloropropene, Cis-1,3-	1.84E-02	1.8E-02	0.5%
Manganese	1.78E+00	1.8E+00	46.5%
Methylene Chloride	2.00E-04	2.0E-04	0.0%
N-Nitrosodiphenylamine	1.88E-01	1.9E-01	4.9%
Pathway-Specific Subtotal	3.8E+00	4E+00	

NA Not applicable.

Ecological Risk Table 1
Exposure:Benchmark Hazard Quotients (HQs) for Aquatic Invertebrates and Fish Potentially Exposed to PCOIs in Surface Water

PCOI	Chronic Hazard Quotient[a] Maximum	Chronic Hazard Quotient[a] Arithmetic Mean	Chronic Benchmark Type	Acute Hazard Quotient[b] Maximum	Acute Hazard Quotient[b] Arithmetic Mean	Acute Benchmark Type	Water Quality Benchmark Reference
Organic Chemicals							
N-Nitrosodiphenylamine	0.12	0.04	Tier II	0.007	0.002	Tier II	Suter & Tsao (1996)
Inorganic Chemicals							
Aluminum	**18.6**	**4.20**	CCC	**2.16**	0.49	CMC	USEPA (1998)
Cadmium	**1.92**	0.72	FCV	0.75	0.28	AMV	MDEQ (1998)
Cobalt	0.21	0.06	FCV	0.06	0.02	AMV	MDEQ (1998)
Lead	0.22	0.14	FCV	0.03	0.02	AMV	MDEQ (1998)
Manganese	**7.94**	**1.08**	Tier II	0.41	0.06	Tier II	Suter & Tsao (1996)
Other							
pH	acceptable[c]		Tier II	acceptable[c]		Tier II	USEPA (1998)

a Chronic Hazard Quotient = Maximum or arithmetic mean concentration / Chronic screening benchmark for surface water.

b Acute Hazard Quotient = Maximum or arithmetic mean concentration / Acute screening benchmark for surface water.

c Minimum and maximum detected concentrations are within the acceptable range for pH (s.u.).

Ecological Risk Table 2
Exposure:Benchmark Hazard Quotients (HQs) for Benthic Invertebrates
Potentially Exposed to PCOIs in Sediment

PCOI	Hazard Quotients (HQs)a								
	NOAA Guidelines			OME Guidelines			NBS, 1996 NEC[c]		
	ER-L[b]	ER-L[c]	ER-M[c]	LEL[b]	LEL[c]	SEL[c]	HA14	CR14	HA28
Organic Chemicals									
Di-n-Butyl Phthalate	not applicable			not applicable			not applicable		
Inorganic Chemicals									
Antimony	**1.61**	**2.20**	0.18	not calculated			not calculated		
Arsenic	0.32	**1.04**	0.40	**1.78**	**5.73**	**1.04**	0.37	0.09	0.34
Barium	not calculated			not calculated			not calculated		
Cadmium	0.35	0.52	0.29	**2.89**	**4.33**	0.26	0.32	0.06	0.32
Lead	0.58	**1.08**	0.34	0.65	**1.22**	0.15	0.55	0.06	0.30
Manganese	not calculated			**1.15**	**2.65**	**1.11**	**1.49**	0.27	0.27
Silver	0.69	**1.90**	0.86	not calculated			not calculated		

a Hazard Quotient = Arithmetic mean or maximum detected concentration / the appropriate sediment screening benchmark value. See Section 5.2 (Benthic Invertebrates).

b Hazard Quotient = Arithmetic mean detected concentration / sediment screening benchmark value.

c Hazard Quotient = Maximum detected concentration / sediment screening benchmark value.

not calculated: sediment screening benchmark value not available. See Table 4-2.

not applicable: benchmark is not applicable.

Ecological Risk Table 3
Exposure:Benchmark Hazard Quotients (HQs) for Soil Flora and Fauna
Potentially Exposed to PCOIs in Surface Soil

PCOI	Hazard Quotients (HQs)[a]								
	Soil Phytotoxicity			Earthworms			Soil Microbes		
	Mean	Maximum	Confidence[b]	Mean	Maximum	Confidence[b]	Mean	Maximum	Confidence[b]
Organic Chemicals									
Di-n-Butyl Phthalate	0.002	0.004	*Low*	not calculated			not calculated		
Pentachlorophenol	0.33	0.40	*Low*	0.16	0.20	*Low*	0.002	0.003	*Low*
Inorganic Chemicals									
Arsenic	**1.29**	**2.20**	*Moderate*	0.21	0.37	*Low*	0.13	0.22	*Low*
Cadmium	0.47	0.75	*High*	0.09	0.15	*Moderate*	0.09	0.15	*High*
Cobalt	0.29	0.48	*Low*	not calculated			0.006	0.01	*Low*
Lead	**1.14**	**5.72**	*Moderate*	0.11	0.57	*Low*	0.06	0.32	*High*
Manganese	**1.47**	**5.12**	*Low*	not calculated			**7.37**	**25.6**	*Low*
Nickel	0.44	0.70	*Low*	0.07	0.11	*Low*	0.15	0.23	*High*
Selenium	**1.02**	**4.90**	*Low*	0.01	0.07	*Low*	0.01	0.05	*Moderate*
Zinc	**1.37**	**3.16**	*Moderate*	0.34	0.79	*Moderate*	0.68	**1.58**	*High*

a Hazard Quotient = Mean or maximum detected concentration / soil screening benchmark value

b Levels of confidence assigned to benchmark values (Efroymson *et al*., 1997a, 1997b).
Low = Screening benchmark based on less than 10 reported literature values.
Moderate = Screening benchmark based on 10 to 20 reported literature values.
High = Screening benchmark based on more than 20 reported literature values.
not calculated: no soil screening benchmark available.

Ecological Risk Table 4
Hazard Quotients for Aquatic-Feeding Wildlife Receptors of Interest
Potentially Exposed to Surface Water PCOIs

PCOIs	Total Hazard Quotients (HQ)[a]							
	Piscivorous bird Belted kingfisher		Invertivorous bird Spotted sandpiper		Piscivorous mammal Mink		Invertivorous mammal Raccoon	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Organic Chemicals								
N-Nitrosodiphenylamine	not calculated	not calculated	not calculated	not calculated	0.00007	0.00002	0.00009	0.00002
Inorganic Chemicals								
Aluminum	0.0004	not calculated	0.0005	not calculated	0.2	0.02	0.3	0.03
Cadmium	0.5	0.03	0.5	0.04	0.3	0.03	0.4	0.04
Cobalt	not calculated	not calculated	not calculated	not calculated	0.002	0.0005	0.002	0.0005
Lead	0.04	0.01	0.2	0.05	0.01	0.001	0.03	0.003
Manganese	0.001	not calculated	0.008	not calculated	0.02	0.01	0.08	0.03

a HQ = Total ADD / TRV; based on maximum detected surface water concentrations.

Total ADD = Sum of exposure from incidental ingestion of sediment, and the ingestion of surface water and prey.

TRVs are presented in Appendix F.

not calculated: TRV not available.

Ecological Risk Table 5
Hazard Quotients (HQs) for Terrestrial-Feeding Wildlife Receptors of Interest Potentially Exposed to Sediment PCOIs[a]

	Total Hazard Quotients (HQs)a							
	Piscivorous bird Belted Kingfisher		Invertivorous bird Spotted Sandpiper		Piscivorous mammal Mink		Invertivorous mammal Raccoon	
PCOI	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Organic Chemicals								
Di-n-Butyl Phthalate	0.8	0.09	0.2	0.02	0.0006	0.0002	0.0001	0.00005
Inorganic Chemicals								
Antimony	not calculated	not calculated	not calculated	not calculated	1	0.1	2	0.2
Arsenic	0.01	0.02	0.04	0.05	0.8	0.3	2	0.9
Barium	0.002	0.003	0.01	0.01	0.01	0.01	0.03	0.05
Cadmium	0.5	0.05	0.5	0.06	0.26	0.04	0.4	0.06
Lead	0.04	0.02	0.2	0.10	0.006	0.001	0.03	0.005
Manganese	0.001	not calculated	0.008	not calculated	0.01	0.01	0.08	0.06
Silver	not calculated	not calculated	not calculated	not calculated	0.0006	0.0008	0.0009	0.001

a NOAEL Hazard Quotient = Mean concentration in sediments / ROI-specific NOAEL sediment quality benchmark.
LOAEL Hazard Quotient = Maximum detected concentration in sediment / ROI-specific LOAEL sediment quality benchmark.
not calculated: sediment screening benchmark value not available. See Appendix F.

Ecological Risk Table 6
Hazard Quotients for Terrestrial-Feeding Wildlife Receptors of Interest Potentially Exposed to Surface Water PCOIs

Surface Water PCOIs	Total Hazard Quotients (HQ)[a]							
	Herbivorous bird Northern bobwhite		Invertivorous bird American woodcock		Herbivorous mammal Meadow vole		Invertivorous mammal Short-tailed shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Organic Chemicals								
N-Nitrosodiphenylamine	not calculated	not calculated	not calculated	not calculated	0.00006	0.00002	0.00005	0.00001
Inorganic Chemicals								
Aluminum	0.0003	not calculated	0.0003	not calculated	0.2	0.02	0.2	0.02
Cadmium	0.02	0.001	1	0.09	0.03	0.003	0.6	0.06
Cobalt	not calculated	not calculated	not calculated	not calculated	0.006	0.001	0.04	0.01
Lead	0.04	0.01	0.8	0.20	0.01	0.001	0.09	0.01
Manganese	0.002	not calculated	0.008	not calculated	0.06	0.02	0.08	0.02

a HQ = Total ADD / TRV; based on maximum detected surface water concentrations.

Total ADD = Sum of exposure from incidental ingestion of soil, and the ingestion of surface water and prey.

TRVs are presented in Appendix F.

Ecological Risk Table 7
Hazard Quotients (HQs) for Terrestrial-Feeding Wildlife Receptors of Interest Potentially Exposed to Soil PCOIs[a]

	Total Hazard Quotients (HQ)a							
	Herbivorous bird Northern Bobwhite Quail		Invertivorous bird American Woodcock		Herbivorous mammal Meadow Vole		Invertivorous mammal Short-tailed Shrew	
PCOI	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Organic Chemicals								
Di-n-Butyl Phthalate	0.002	0.0006	0.08	0.02	0.000003	0.000002	0.00005	0.00004
Pentachlorophenol	0.00005	0.00003	0.003	0.002	0.0004	0.0002	0.01	0.004
Inorganic Chemicals								
Arsenic	0.002	0.002	0.04	0.03	0.3	0.05	3	0.5
Cadmium	0.02	0.002	1	0.1	0.03	0.005	0.6	0.09
Cobalt	not calculated	not calculated	not calculated	not calculated	0.004	0.002	0.04	0.02
Lead	0.04	0.05	0.8	1	0.01	0.005	0.09	0.05
Manganese	0.002	not calculated	0.008	not calculated	0.06	0.06	0.08	0.08
Nickel	0.0002	0.0002	0.008	0.009	0.0007	0.0006	0.01	0.01
Selenium	0.006	0.01	0.37	0.88	0.007	0.02	0.2	0.6
Zinc	0.2	0.04	2	0.52	0.01	0.01	0.04	0.04

a NOAEL Hazard Quotient = Mean concentration in soils / ROI-specific NOAEL soil quality benchmark.
LOAEL Hazard Quotient = Maximum detected concentration in soil / ROI-specific LOAEL soil quality benchmark.
not calculated: soil screening benchmark value not available. See Appendix F.

ARAR Tables

TABLE A-1
Federal Chemical-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
National Primary Drinking Water Standards	40 C.F.R. Part 141	Establishes health-based standards for public water systems (maximum contaminant levels).	Yes	The MCLs for organic and inorganic contaminants are relevant and appropriate for groundwater.
National Secondary Drinking Water Standards	40 C.F.R. Part 143	Establishes welfare-based standards for public water systems (secondary maximum contaminant levels).	Yes	Secondary MCLs for inorganic contaminants are relevant and appropriate for groundwater.
Maximum Contaminant Level Goals	40 C.F.R. Part 141	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects with an adequate margin of safety.	No	Proposed MCLGs for organic contaminants should be treated as "other criteria, advisories, and guidance".
Water Quality Criteria	40 C.F.R. Part 131 Quality Criteria for Water, 1986	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Yes	AWQCs are most likely to be relevant and appropriate for surface water discharges.
Direct Discharges	40 C.F.R. Part 122	Controls the direct discharges of pollutants to surface waters through NPDES	Yes	Discharge of treated wastewater from control technology to off-site surface water is relavant and appropriate.
Indirect Discharges	40 C.F.R. Part 403	Controls indirect discharges of treated wastewater to POTW's	Yes	Discharge of treated wastewater from control technology to off-site POTW's is relavant and appropriate.
Toxic Pollutant Effluent Standards	40 C.F.R. Part 129	Establishes effluent standards or prohibitions for certain toxic pollutants: aldrin/dieldrin, DDT, endrin, toxaphene, benzidine, PCBs.	No	These pollutants were not detected in groundwater samples.
Identification and Listing of Hazardous Waste	40 C.F.R. Part 261	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 C.F.R. parts 262-265 and Parts 124, 270, 271.	Yes	RCRA regulations to wastes found at this site is applicable.
Releases from Solid Waste Management Units	40 C.F.R. Part 264 Subpart F	Establishes maximum contaminant concentrations that can be released from hazardous waste units In Part 264, Subpart F.	Yes	On-site hazardous waste management unit may be considered.

TABLE A-1
Federal Chemical-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
PCB Requirements	40 C.F.R. Part 761 Subpart G	Establishes regulations concerning the manufacture, processing, distribution, use, disposal, storage, and marking of PCB items	No	PCB pollutants were not detected at the site
National Ambient Air Quality Standards	40 C.F.R. Part 50	Establishes primary (health based) and secondary (welfare based) standards for air	Yes	Standards applicable to maintenance of air quality at the site.
National Emission Standards for Hazardous Air Pollutants	40 C.F.R. Part 61	Establishes emission levels for certain hazardous air pollutants.	Yes	Standards for some chemicals may be relevant and appropriate to the site.
New Source Performance Standards	40 C.F.R. Part 59	Ensures that emissions are maintained at certain sources that may be treating pollutants generated during a response action	Yes	Pollutants emitted from technology employed for response action may be sufficiently similar to an NSPS designated category.
Occupational Health and Safety Regulations	29 C.F.R. 1910.1000 Subpart Z	Establishes permissible exposure limits for workplace exposure to many chemicals.	Yes	Listed chemicals detected on-site. Standards applicable to remedial worker

TABLE A-2
State Chemical-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Michigan Safe Drinking Water Act	Michigan Safe Drinking Water Act Public Act 399 of 1976, as amended. (Michigan Compiled Laws (MCL) 325.1001)Michigan Administrative Code:R 325.10101, R 325.10601, et. seq.	Regulates all waters used or potentially used for drinking water. Adopts Federal Maximum Contaminant Levels as state drinking water standards. Ensures that acceptable concentrations of chemical constituents in groundwater do not exceed drinking water standards	Yes	Applied when releases of hazardous substances may impact groundwater and/or surface waters used for private and/or public water supplies
Water Resources Protection	Part 31, of The Natural Resources and Environmental Protection Act, 1994 PA 451. Michigan Administrative Code:R 324.3103, et. seq..;Part 4: (R 323.1041-1117); Part 21: (R 323.2106, R 323.2108-9, R 323.2114, R 323.2117-2119, R 323.2128, R 323.2136, R 323.2145, R 323.2149-2151, R 323.2154-2155, R 323.2162-2164, and R 323.2190-2192); Part 22: (R 323.2201-2211); and Part 23: (R 323.2301). Formerly known as Act 245 (1929)	These rules address discharges to both surface waters and groundwater of the State. Part 31 prohibits direct or indirect discharge to ground or surface waters of the state that are or may become injurious to the environment or public health. Regulates water and wastewater discharges with standards for discharge to groundwater. Defines effluent guidelines based on actual water quality, receiving stream properties, and other appropriate water quality criteria. Provides criteria and standards for the National Pollutant Discharge Elimination System (NPDES) and effluent standards for toxic pollutants.	Yes	Applied where treated and/or contaminated groundwater and/or wastewater are discharged to surface water or groundwater. Ensures that chemical constituents do not exceed water quality standards. Relevant and appropriate for response activities which will discharge wastewater, treated and/or contaminated groundwater to surface waters of the state. Establishes standards for discharge to groundwater.

TABLE A-2
State Chemical-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Air Pollution Control	Part 55 of Act, 1994 PA 451 (MCL 324.55, et seq.) Michigan Administrative Code:R 324.5501, R 336.1101, R 336.1123, R 336.1127, R 336.1201-1207, R 336.1209-1229, R 336.1230-1241, R 336.1278-1290, and R 336.1299 (Part 3 Emissions Limitations & Prohibitions), R 336.1701–1702 (Part 7 Emissions Limitations and Prohibitions-New Sources of Volatile Organic Compound Emissions), R 336.1901, R 336.2001–2007, et. seq. Formerly known as Act 348 (1965)	Defines air quality standards for potential air emission sources. Prohibits the emissions of air contaminants in quantities that cause injurious effects to human health, animal life, plant life of significant economic value, and/or property or that interfere with the enjoyment of life or property in the state	Yes	Applicable for remedial alternatives that would generate air emissions, i.e., dust, fumes, gas, mist, odor, smoke, vapor, or any combination thereof.
Hazardous Waste Management	Part 111 of Act, 1994 PA 45. (MCL 324.111, et seq.) Michigan Administrative Code:R 299.9202-9208, R 299.9212, R 299.9228, R 299.9301-9312, R 299.9401-9413, R 299.9501-9523, R 299.9601-9634, R 299.9701-9713, R 299.9801-9816, and R 299.11001-11008, et. seq.; Part 2: Identification and Listing of Hazardous Waste ;Part 3: Generators of Hazardous Waste; Part 4: Transporters of Hazardous Waste; Part 5: Construction Permits and Operating Licenses; Part 6: Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities; Part 8: Management of Specific Hazardous Wastes, Specific Types of Hazardous Waste. Formerly known as Act 64 (1979).	Defines hazardous waste and establishes requirements for hazardous waste generators, transporters, and treatment/storage/disposal facilities. It is the implementing statute for the federally delegated program under the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments (HSWA). Regulates the generation, transport, treatment, storage, and disposal of hazardous wastes from site remediation. Regulates closure, post-closure, and corrective action for hazardous waste treatment, storage and disposal facilities	Yes	Must be complied with by persons engaging in activities, which would generate, transport, treat, store or dispose of hazardous waste in this state. Administrative Rules define hazardous waste based on analytical procedures, usage, and process of generation. Response activities may generate waste residuals that may be classified as hazardous waste. Used for characterizing and identifying hazardous wastes and determining appropriate treatment and disposal.

TABLE A-2
State Chemical-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
PCB Compounds	Part 147, of Act, 1994 PA 451. (MCL 299.3301, et seq.) Michigan Administrative Code: R 299.5101 et. seq. Formerly known as Act 60 (1976)	Requirements for notifying the MDEQ of the intent to use, sell, or manufacture PCBs or PCB products. Requirements for annual reporting, exemptions and exclusions, and labeling, as well as provisions for the storage, handling, transportation, and disposal of PCBs or PCB-contaminated materials	No	Regulates the disposal of solid or liquid waste resulting from the use of PCB or an item, product, or material containing a concentration equal to or greater than or equal to 50 ppm of PCB except in conformity with rules promulgated by the department. PCBs are primarily regulated by the federal Toxic Substances Control Act (TSCA) requirements. No PCBs were detected at the site
Environmental Remediation	Part 201of Act, 1994 PA 451. (MCL 324.201, et seq.) Michigan Administrative Code: R 299.5511(3)(d), et. seq. Formerly known as Act 307 (1982)	In part, protects the environment and natural resources of the state; regulates the discharge of certain substances into the environment; regulates the use of certain lands, waters, and other natural resources of the state; and prescribes the powers and duties of certain state and local agencies and officials.	Yes	Establishes cleanup criteria for sites of environmental contamination based on current and future land use. Regulates cleanup of releases of hazardous substances in concentrations that constitute a facility as that term is defined in Section 20101(o) of Act 451 to soil and groundwater.
MDEQ Mixing Zone Determination Discharge Limits	Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended	Protects the environment and natural resources of the state; determines the discharge of certain substances into the environment to protect against impacts to the aquatic organisms in the waters of the state, the human use of the water and water organisms, and human direct contact exposure.	Yes	Establishes specific discharge limits for the Grand River and Kanouse Drain for the Ionia City Landfill.

TABLE A-3
Federal Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
National Historic Preservation Act	49 U.S.C. 470 40 C.F.R. 6.301(b) 36 C.F.R. Part 800	Requires Federal agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure or object that is included in or eligible for inclusion In the National Register of Historical Places.	No	There are no items located on site which are eligible for inclusion on the National Register of Historical Places.
Archeological and Historical Preservation Act	16 U.S.C. 469 40 C.F.R. 4601(c)	Establishes procedures to provide for preservation of historical and archeological data which might be destroyed through alteration of terrain as a result of a Federal construction Project or a Federally licensed activity or program.	No	No historical or archeological data is at the site.
Historic Sites, Buildings and Antiquities Act	16 U.S.C. 461-467 40 C.F.R. 4601(a) 36 C.F.R. 62.6(d)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	No	There are no items located on siti which are on the National Registry of National Landmarks.
Protection of Wetlands	Exec. Order No. 11,990 40 C.F.R. 6.302(a) and Appendix A	Requires Federal agencies to avoid, to the extent possible, the adverse Impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practical alternative exists.	Yes	The site contains a marshy and wooded area in the south east portion of Area A.
Floodplain Management	Exec. Order No. 11,908 40 C.P.R. 6.302(b) and Appendix A	Requires Federal agencies to evaluate the potential effects of actions they may take In a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain.	Yes	The site is within the 100-year floodplain.
Wilderness Act	16 U.S.C. 1131, 50 C.F.R. 35.1	Requires that Federally owned wilderness areas be maintained in an unimpacted condition.	No	No wilderness areas on-site or adjacent to the site.

TABLE A-3
Federal Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
National Wildlife Refuge System	16 U.S.C. 668	Restricts activities within a national wildlife refuge.	No	No wilderness area on-site or adjacent to the site.
Fish and Wildlife Coordination Act	16 U.S.C. 661-666, 40 C.F.R. 302(g)	Requires consultation when Federal department or agency proposes or authorizes any control or structural modification of any stream or other water body and aqequate provision for protection of fish and wildlife resources.	No	No remedial alternative includes modification of Grand River or its tributaries.
Endangered Species Act	16 U.S.C. 1531, 40 C.F.R. Part 302 (h), 50 C.F.R. Part 402	Requires action to conserve endangered species within critical habitats upon which endangered species depend; includes consultation with Department of Interior.	No	No known endangered species at the site.
Clean Water Act - Dredge or Fill Requirements (Section 404)	33 U.S.C. 1251-1376, 40 C.F.R. Parts 230-231	Requires permits for discharge of dredge or fill material into navigable waters.	No	There will be no discharge of these types of materials into navigable waters.
Rivers and Harbors Act of 1899 - Section 10 Permit	33 U.S.C. 403, 33 C.F.R. Parts 320-330	Requires permit for structures or work in or affecting navigable waters.	No	No remedial alternative includes structures or work in or affecting navigable waters.

TABLE A-4
State Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Water Resources Protection	Part 31, of Act, 1994 PA 451. (MCL 324.3101, et seq.) Michigan Administrative Code: R 324.3101, et. seq.; Part 4: Michigan water quality standards for surface waters to protect public health and welfare, enhance and maintain water quality, and protect the state's natural resources (R 323.1041-1117); Part 5: Spillage of oil and polluting materials addresses spill containment, prevention, clean-up, and reporting (R 323.1158, et. seq.); Part 8: Water quality based effluent limits for toxic chemicals (R 323.1201-1221); Part 13: Floodplains and floodways (R 323.1311-1315 and R 323.1329); Part 21: Wastewater discharge permits identifies NPDES and State groundwater discharge requirements, including procedures for permit application, permit issuance, and denial (R 323.2106, R 323.2108-9, R 323.2114, R 323.2117-2119, R 323.2128, R 323.2136, R 323.2145, R 323.2149-2151, R 323.2154-2155, R 323.2162-2164, and R 323.2190-2192); Part 22: Groundwater quality rules R 323.2201-2240). Formerly known as Act 245 (1929)	These rules address discharges to both surface waters and groundwater of the State. Regulates water and wastewater discharge standards for discharge to groundwater. Defines effluent guidelines based on actual water quality, receiving stream properties, and other appropriate water quality criteria. Provides criteria and standards for the National Pollutant Discharge Elimination System (NPDES) and effluent standards for toxic pollutants. Also includes the Industrial Pre-treatment Program (IPP) and Publicly Owned Treatment Works (POTW) requirements	Yes	Remedial action may result in the discharging of remediated and unremediated contaminated groundwater into waters of the state, i.e., groundwater, surface water, or any other water course. Applicable for remedial alternatives which will treat and/or discharge wastewater to surface waters of the state. Cites specific requirements for the discharge of bioaccumulative chemicals. Discharge requirements can be identified through a substantive requirements document (SRD). Prevents concentrations in surface water of taste and odor producing substances. Prevents acutely and chronically toxic substances from entering surface water based on the LC50 toxicity criteria. Prevents degradation of water quality. Restricts levels of turbidity, color, oil films, floating solids, foams, settling and suspended solids, and deposits.

TABLE A-4
State Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Soil Erosion and Sedimentation Control	Part 91of Act, 1994 PA 451. (MCL 324.9101, et seq.) Michigan Administrative Code: R 323.1701 et. seq. Formerly known as Act 347 (1972)	Requires a soil erosion control and sedimentation plan for any earth changes of one or more acres and/or any earth changes within 500 feet of a lake or stream. Establishes rules prescribing soil erosion and sedimentation control plans, procedures, and measures.	Yes	If remedial construction takes place within 500 feet of the Grand River.
Environmental Remediation	Part 201of Act, 1994 PA 451. (MCL 324.201, et seq.) Michigan Administrative Code: R 299.5511(3)(a), et. seq. Formerly known as Act 307 (1982)	In part, protects the environment and natural resources of the state; regulates the discharge of certain substances into the environment; regulates the use of certain lands, waters, and other natural resources of the state; and prescribes the powers and duties of certain state and local agencies and officials.	Yes	Establishes cleanup criteria for sites of environmental contamination based on current and future land use. Regulates cleanup of releases of hazardous substances in concentrations that constitute a facility as that term is defined in Section 20101(o) of Act 451 to soil and groundwater
Leaking Underground Storage Tanks	Part 213 of Act, 1994 PA 451. (MCL 324.213, et seq.) Michigan Administrative Code: R 324.21301a, et. seq.	Regulates and provides for corrective action due to releases from leaking underground storage tank systems. Prescribes the powers and duties of certain state agencies and officials; and provides for penalties and remedies. Also regulates the inspection, abandonment, replacement and installation of underground storage tanks.	No	No USTs are present at the site.

TABLE A-4
State Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Inland Lakes and Streams	Part 301of Act, 1994 PA 451. (MCL 324.30101, et seq.). Michigan Administrative Code: R 281.811, etc., et. seq. Formerly known as Act 346 (1972)	Except as provided in this part, a person without a permit from the department shall not do any of the following: a) Dredge or fill bottomland; b) Construct, enlarge, extend, remove, or place a structure on bottomland; c) Erect, maintain, or operate a marina; d) Create, enlarge, or diminish an inland lake or stream; e) Structurally interfere with the natural flow of an inland lake or stream; f) Construct, dredge, commence, extend, or enlarge an artificial canal, channel, ditch, lagoon, pond, lake, or similar waterway where the purpose is ultimate connection with an existing inland lake or stream, or where any part of the artificial water way is located within 500 feet of the ordinary high-water mark of an existing inland lake or stream; and g) Connect any natural or artificially constructed waterway, canal, channel, ditch, lagoon, pond, lake, or similar water with an existing inland lake or stream for navigation or any other purpose.	Yes	Construction of structure (outfall) in bottomland is possible as a component of remedial alternative.
Wetland Protection	Part 303 of Act, 1994 PA 451. (MCL 324.30301, et seq.) Michigan Administrative Code: R 281.921, et. seq. Formerly known as Act 203 (1979)	Prohibits the construction, operation, or maintenance of any use or development in regulated wetlands (324.30301(d)) without a permit. Prohibited activities include draining, dredging, filling, or maintaining a use or development in a wetland. Regulates permit applications	Yes	The Site contains a marshy wooded area in the south east portion of Area A considered a wetland.

TABLE A-4
State Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Natural Rivers	Part 305 of Act, 1994 PA 451. (MCL 324.203, et seq.) Michigan Administrative Code: R 324.30501 et. seq. Formerly known as Act 231 (1970)	Regulates activities within 500 feet of a designated natural river. The purpose of these zoning rules is to promote public health and prevent ecological damage due to unwise development or construction within a natural river district. The rules also protect the free-flowing conditions, fish and wildlife, water quality, and recreational values of natural rivers and adjoining land.	Yes	Construction of a component of a remedial alternative is possible near the Grand River.
Dam Safety	Part 315 of Act, 1994 PA 451. (MCL 324.31501, et. seq.). Michigan Administrative Code: R 281.1301, et. seq	Regulates dam and/or surface water impoundment structures at or greater than 6 feet in height.	No	No dams or impoundment structures exist at the site.
Shorelands Protection and Management	Part 323 of Act, 1994 PA 451. (MCL 324.32301, et seq.) Michigan Administrative Code: R 281.21, et. seq. Formerly known as Act 245 (1970)	Regulates the alteration of the soil and vegetation within a Great Lakes shoreland environmental area without a permit. Regulates activities in high-risk erosion areas and flood risk areas (administered by local units of government through the federal flood insurance program) as well as environmental areas.	No	Site is not located in a Great Lakes shoreland area.
Great Lakes Submerged Lands	Part 325 of Act, 1994 PA 451. (MCL 324.32501, et seq.) Michigan Administrative Code: R 322.1001, et. seq. Formerly known as Act 247 (1974)	Regulates activities in unpatented lake bottomlands and unpatented made lands in the Great Lakes at elevations below the international Great Lakes datum of 1955: Lake Superior, 601.5 feet; Lakes Michigan and Huron, 579.8 feet; Lake St. Clair, 574.7 feet; and Lake Erie, 571.6 feet.	No	No construction activity will take place at elevations below the international Great Lakes datum.

TABLE A-4
State Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Great Lakes Preservation	Part 327 of Act, 1994 PA 451. (MCL 324.327, et seq.) Michigan Administrative Code: R 324.32701, et. seq.	The waters of the state are valuable public natural resources held in trust by the state, and the state has a duty as trustee to manage its waters effectively for the use and enjoyment of present and future residents and for the protection of the environment. The waters of the Great Lakes within the boundaries of this state shall not be diverted out of the drainage basin of the Great Lakes.	No	No water diversion out of the drainage basin will occur.
Great Lakes Protection	Part 329 of Act 1994 PA 451. (MCL 324.329, et seq.) Michigan Administrative Code: R 324.32901, et. seq.	Careful management of the Great Lakes will permit the rehabilitation and protection of the lakes, their waters, and their ecosystems, while continuing and expanding their use for industry, food production, transportation, and recreation.	No	Site is not located next to the Great Lakes.
Wilderness and Natural Areas	Part 351of Act 1994 PA 451. (MCL 324.351, et seq.) Michigan Administrative Code: R 324.35101, et. seq. Formerly known as Act 241 (1972)	Enacted to designate, protect and preserve wilderness and natural areas. Prohibits removing, cutting, picking, or otherwise altering vegetation, except as necessary for appropriate public access, the preservation or restoration of a plant or wildlife species, or the documentation of scientific values and with written consent of the department, except as provided in subsection (2), granting an easement for any purpose.	Yes	May be applied to areas located in or near designated wilderness and natural areas.

TABLE A-4
State Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Sand Dunes Protection and Management	Part 353 of Act, 1994 PA 451. (MCL 324.35301, et seq.) Michigan Administrative Code: None for critical dune areas.	Regulates the protection and management of sand dunes only in designated critical dune areas. The Geological Survey Division regulates sand mining in dune areas under Part 637.	No	No dune areas exist around the vicinity of the site.
Farmland and Open Space Preservation	Part 361of Act, 1994 PA 451. (MCL 324.361, et seq.) Michigan Administrative Code: R 324.36101, et. seq.	Regulates activities to prevent the destruction of farmland and open spaces.	Yes	Farmland exists adjacent to the site where construction activities are possible to occur.
Endangered Species Protection	Part 365 of Act, 1994 PA 451. (MCL 324.365, et seq.) Michigan Administrative Code: R 324.36501, R 299.1021 – R 299.1028, et. seq. Formerly known as Act 203 (1974)	Establishes rules to provide for conservation, management, enhancement, and protection of species either endangered or threatened with extinction. Habitat listed on the Michigan Natural Features Inventory and Part 365 will need to be protected. The rules contain a listing of the fish, wildlife, and plant species that have been determined to be endangered or threatened	Yes	Remedial action may take place and adversely impact endangered species and other habitat
Wildlife Conservation	Part 401 of Act, 1994 PA 451. (MCL 324.401, et seq.) Michigan Administrative Code: R 324.40102, et. seq.	Regulates wildlife conservation	Yes	May be applied to identifying wildlife habitat near the site where an ecological risk assessment(s) may be conducted. May be used in conjunction with the Michigan Features Inventory List to identify habitat where an environmental site of contamination may impact wildlife.

TABLE A-4
State Location-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Protection and Preservation of Fish, Game, and Birds	Part 411 of Act, 1994 PA 451. (MCL 324.411, et seq.) Michigan Administrative Code: R 324.41101, et. seq.	Regulates the protection and preservation of fish, game, and birds	Yes	May be applied to site remediation to protect and preserve fish, game and birds
Fisheries Contamination	Part 479 of Act 1994 PA 451. (MCL 324.479, et seq.) Michigan Administrative Code: R 324.47903-47905, et. seq.	Used to ensure the protection of aquatic species within waters of the state. A person shall not put into any stream, pond, or lake any sand, coal, cinders, ashes, log slabs, decayed wood, bark, sawdust, or filth.	Yes	May be applied to site remediation to protect and/or restore aquatic life.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
CLEAN WATER ACT	33 U.S.C 1251-1376			
National Pollutant Discharge Elimination System (NPDES)	40 C.F.R Part 125	Requires permits for the discharge of pollutants from any point source into water of the United States.	Yes	A permit will be required for discharge if on-site groundwater treatment occurs and is discharged to the Grand River.
Effluent Guidelines and Standards for the Point Source Category	40 C.F.R Part 414	Requires specific effluent characteristics for discharge under NPDES permits.	No	No direct applicability because there is no on-going commercial activity.
National Pretreatment Standards	40 C.F.R. Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in public treatment works or which may contaminate sewage sludge.	Yes	Only if the selected alternative includes a discharge to a publically owned treatment works.
SOLID WASTE DISPOSAL ACT ("SWDA")	42 U.S.C. 6901-6987			
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 C.F.R Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on public healthor the environment and thereby constitute prohibited open dumps.	Yes	Only if selected alternative includes on-site disposal.
Hazardous Waste Management Systems	40 C.F.R Part 260	Establishes procedure and criteria for modification or revocation of provisions in 40 C.F.R. Part 260-265.	No	Creates no substantive cleanup requirements.
Standards Applicable to Generators of Hazardous Waste	40 C.F.R. Part 262	Establishes standards for generators of hazardous waste.	Yes	If remedial action alternative involves off-site transportation of either soil or groundwater for treatment or disposal.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Standards Applicable to Transporters of Hazardous Waste	40 C.F.R. Part 263	Establishes standards which apply to transporters of hazardous waste within the U.S. if the transportation requires a manifest under 40 C.F.R.	Yes	If remedial action alternative involves off-site transportation of either soil or groundwater for rteatment or disposal.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 C.F.R. Part 264	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	The site contains RCRA listed hazardous wastes. Part 264 requirements may be appliable for certain remedial actions. SEE EACH SUBPART BELOW
General Facility Standards	Subpart B	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	Relevant and appropriate if any remedial actions are selected for which other Subparts of 264 are relevant and appropriate.
Preparedness and Prevention	Subpart C	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	No substantive cleanup requirements.
Contingency Plan and Emergency Procedures	Subpart D	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If groundwater treatment system installed and produces hazardous waste.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Manifest System, Recordkeeping, Reporting	Subpart E	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If groundwater treatment system, produces hazardous waste.
Releases from Solid Waste Management Units	Subpart F	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative results in releases from on-site solid waste management units established as a remedial action.
Closure and Post-Closure	Subpart G	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	CERCLA establishes review of remedial actions should contaminants remain on-site. RCRA substantive requirements include deed notices and monitoring.
Financial Requirements	Subpart H	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	No	No substantive requirements.
Use and Management of Containers	Subpart I	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve storage of containers.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Tanks	Subpart J	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If the alternative would involve use of tanks to treat or store hazardous materials.
Surface Impoundments	Subpart K	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve a surface impoundment to treat, store or dispose of hazardous materials.
Waste Piles	Subpart L	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would treat or store hazardous materials in piles.
Land Treatment	Subpart M	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve land treatment.
Landfills	Subpart N	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve disposal of hazardous materials in a landfill.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Incinerators	Subpart O	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If an incinerator alternative is developed.
Interim Standards for the Management of Specific Hazardous Wastes and Specific Types of Management Facilities	40 C.F.R. Part 265	Establishes minimum national standards which the acceptable management of hazardous waste during the period of interim status and until certification of final closure or if the facility is subject to p[ost-closure requirements, until post-closure responsibilities are fulfilled.	No	Remedies should be consistent with the more stringent Part 264 standards as these represent the ultimate RCRA compliance standards and are consistent with CERCLA's goal of long term protection of public health and welfare and the environment.
Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	40 C.F.R. Part 266	Establishes requirements which apply to recyclable materials that are reclaimed to recover economivcally significant amount of precious metals.	No	No known recyclable materials on-site.
Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities	40 C.F.R. Part 267	Establishes minimum national standards which the acceptable management of hazardous wastes for new land disposal facilities.	No	Remedies should be consistent with the more stringent Part 264 standards as these represent the ultimate RCRA compliance standards and are consistent with CERCLA's goal of long term protection of public health and welfare and the environment.
Land Disposal	40 C.F.R. Part 268	Establishes restriction for burial of wastes and other hazardous materials.	Yes	If an alternative developed would involve burial of contaminated soils or residues containing prohibited wastes - CERCLA waiver may be required.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Hazardous Waste Permit Program	40 C.F.R. Part 270	Establishes provisions covering basic EPA permitting requirements.	No	A permit is not required for on-site CERCLA response actions. Substantive requirements are addressed in 40 C.F.R. Part 264.
Underground Storage Tanks	40 C.F.R. Part 280	Establishes provisions covering underground storage tanks.	No	No alternative involving the use of underground storage tanks is anticipated.
OCCUPATIONAL SAFETY AND HEALTH ACT	29 U.S.C. 651-678 29 C.F.R. Part 1910	Regulates worker health and safety at hazardous wastes sites.	Yes	Under 40 C.F.R. 300.38, requirements of the Act apply to all response activities under the NCP.
SAFE DRINKING WATER ACT	40 C.F.R. Parts 144-147			
Underground Injection Control Regulations	40 C.F.R. Parts 144-147	Provides for protection of underground sources of drinking water.	Yes	If a groundwater remediation involves injection to enhance cleanup.
HAZARDOUS MATERIALS TRANSPORTATION ACT	49 U.S.C. 1801-1813			
Hazardous Materials Transportation Regulations	49 C.F.R. Parts 171-178	Regulates transportation of hazardous materials.	Yes	If an alternative developed would involve transportation of Hazardous materials.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
CLEAN WATER ACT	33 U.S.C 1251-1376			
National Pollutant Discharge Elimination System (NPDES)	40 C.F.R Part 125	Requires permits for the discharge of pollutants from any point source into water of the United States.	Yes	A permit will be required for discharge if on-site groundwater treatment occurs and is discharged to the Grand River.
Effluent Guidelines and Standards for the Point Source Category	40 C.F.R Part 414	Requires specific effluent characteristics for discharge under NPDES permits.	No	No direct applicability because there is no on-going commercial activity.
National Pretreatment Standards	40 C.F.R. Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in public treatment works or which may contaminate sewage sludge.	Yes	Only if the selected alternative includes a discharge to a publically owned treatment works.
SOLID WASTE DISPOSAL ACT ("SWDA")	42 U.S.C. 6901-6987			
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 C.F.R Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on public healthor the environment and thereby constitute prohibited open dumps.	Yes	Only if selected alternative includes on-site disposal.
Hazardous Waste Management Systems	40 C.F.R Part 260	Establishes procedure and criteria for modification or revocation of provisions in 40 C.F.R. Part 260-265.	No	Creates no substantive cleanup requirements.
Standards Applicable to Generators of Hazardous Waste	40 C.F.R. Part 262	Establishes standards for generators of hazardous waste.	Yes	If remedial action alternative involves off-site transportation of either soil or groundwater for treatment or disposal.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Standards Applicable to Transporters of Hazardous Waste	40 C.F.R. Part 263	Establishes standards which apply to transporters of hazardous waste within the U.S. if the transportation requires a manifest under 40 C.F.R.	Yes	If remedial action alternative involves off-site transportation of either soil or groundwater for treatment or disposal.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 C.F.R. Part 264	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	The site contains RCRA listed hazardous wastes. Part 264 requirements may be appliable for certain remedial actions. SEE EACH SUBPART BELOW
General Facility Standards	Subpart B	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	Relevant and appropriate if any remedial actions are selected for which other Subparts of 264 are relevant and appropriate.
Preparedness and Prevention	Subpart C	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	No substantive cleanup requirements.
Contingency Plan and Emergency Procedures	Subpart D	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If groundwater treatment system installed and produces hazardous waste.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Manifest System, Recordkeeping, Reporting	Subpart E	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If groundwater treatment system, produces hazardous waste.
Releases from Solid Waste Management Units	Subpart F	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative results in releases from on-site solid waste management units established as a remedial action.
Closure and Post-Closure	Subpart G	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	CERCLA establishes review of remedial actions should contaminants remain on-site. RCRA substantive requirements include deed notices and monitoring.
Financial Requirements	Subpart H	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	No	No substantive requirements.
Use and Management of Containers	Subpart I	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve storage of containers.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Tanks	Subpart J	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If the alternative would involve use of tanks to treat or store hazardous materials.
Surface Impoundments	Subpart K	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve a surface impoundment to treat, store or dispose of hazardous materials.
Waste Piles	Subpart L	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would treat or store hazardous materials in piles.
Land Treatment	Subpart M	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve land treatment.
Landfills	Subpart N	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If alternative would involve disposal of hazardous materials in a landfill.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Incinerators	Subpart O	Establishes minimum national standards which the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose hazardous waste.	Yes	If an incinerator alternative is developed.
Interim Standards for the Management of Specific Hazardous Wastes and Specific Types of Management Facilities	40 C.F.R. Part 265	Establishes minimum national standards which the acceptable management of hazardous waste during the period of interim status and until certification of final closure or if the facility is subject to p[ost-closure requirements, until post-closure responsibilities are fulfilled.	No	Remedies should be consistent with the more stringent Part 264 standards as these represent the ultimate RCRA compliance standards and are consistent with CERCLA's goal of long term protection of public health and welfare and the environment.
Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	40 C.F.R. Part 266	Establishes requirements which apply to recyclable materials that are reclaimed to recover economivcally significant amount of precious metals.	No	No known recyclable materials on-site.
Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities	40 C.F.R. Part 267	Establishes minimum national standards which the acceptable management of hazardous wastes for new land disposal facilities.	No	Remedies should be consistent with the more stringent Part 264 standards as these represent the ultimate RCRA compliance standards and are consistent with CERCLA's goal of long term protection of public health and welfare and the environment.
Land Disposal	40 C.F.R. Part 268	Establishes restriction for burial of wastes and other hazardous materials.	Yes	If an alternative developed would involve burial of contaminated soils or residues containing prohibited wastes - CERCLA waiver may be required.

TABLE A-5
Federal Action-Specific ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Hazardous Waste Permit Program	40 C.F.R. Part 270	Establishes provisions covering basic EPA permitting requirements.	No	A permit is not required for on-site CERCLA response actions. Substantive requirements are addressed in 40 C.F.R. Part 264.
Underground Storage Tanks	40 C.F.R. Part 280	Establishes provisions covering underground storage tanks.	No	No alternative involving the use of underground storage tanks is anticipated.
OCCUPATIONAL SAFETY AND HEALTH ACT	29 U.S.C. 651-678 29 C.F.R. Part 1910	Regulates worker health and safety at hazardous wastes sites.	Yes	Under 40 C.F.R. 300.38, requirements of the Act apply to all response activities under the NCP.
SAFE DRINKING WATER ACT	40 C.F.R. Parts 144-147			
Underground Injection Control Regulations	40 C.F.R. Parts 144-147	Provides for protection of underground sources of drinking water.	Yes	If a groundwater remediation involves injection to enhance cleanup.
HAZARDOUS MATERIALS TRANSPORTATION ACT	49 U.S.C. 1801-1813			
Hazardous Materials Transportation Regulations	49 C.F.R. Parts 171-178	Regulates transportation of hazardous materials.	Yes	If an alternative developed would involve transportation of Hazardous materials.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Michigan Vehicle Code	Public Act 300 of 1949, as amended. (MCL 257.722, et seq.) Michigan Administrative Code: Size, Weight and Load (R 257.716-726).	Rules governing the reduction of maximum axle loads during springtime frost periods. Maximum Gross Vehicle Weight (GVW) is not to exceed 25-35% of normal GVW. County road jurisdiction- County Road Commission and state roads and highway jurisdiction- MDOT. Motor Carrier enforces the above	Yes	Used to prevent vehicular damage to roadways from transporting heavy materials and equipment. Remedial action and construction may require heavy loads of equipment, fill dirt, contaminated media, etc. to be transported over roadways; however, this is not allowed during frost periods
Michigan Occupational Safety and Health Act (MIOSHA)	The Michigan Occupational Safety and Health Act (MIOSHA) Public Act 154 of 1974, as amended.	Occupational safety and health standards adopted to provide safe and healthful employment or places of employment, which may include medical monitoring. Provides safety standards for hazards, air contaminants, physical hazards, health hazard control measures, illumination, sanitation, employee right-to-know, and others. Regulations containing worker health and safety standards for construction and general industry operations and requirements for worker training specifically "Hazardous Waste Operations and Emergency Response (HAZWOPER)." This is the statute adopted by Michigan from the Federal OSHA. Rules contain a list of permissible exposure limits in the work place for more than 600 chemical compounds	Yes	On-site remedial actions have the potential to expose workers to contaminants found in affected media, i.e., soil, air and water. Construction, excavation and other site actions may present potential health hazards to nearby workers. Human labor will likely be required to construct remedial systems as well as provide long-term routine/non-routine maintenance on the systems. Such activities are governed by worker safety and health standards under this act and are applicable to all site actions and activities.
Public Health Code	Public Act 368 of 1978, as amended. (MCL 333.1101, et seq.) Michigan Administrative Code: Part 127: Groundwater Quality Control (R 325.1601, etc.)	Regulates construction of private drinking water wells. Water supply well standards and requirements which regulate the construction and abandonment of private drinking water wells. Establishes distance requirements from pollution sources.	Yes	Provides general guidelines and requirements on how a well is constructed and abandoned to prevent leakage to aquifers of the state. May apply to response activities affecting water supply wells, may apply to future land uses around the area of the site.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Environmental Protection	Part 17 of Act, 1994 PA 451. (MCL 324.17, et seq.) Michigan Administrative Code: R 324.1701, et. seq. Formerly known as Act 127 (1970)	Provides for the protection of natural resources. The protection of state resources prohibits any action that pollutes, impairs, or destroys the state's natural resources, due to any activities conducted at a site of environmental contamination	Yes	Applied in remedial investigation, remedia design, response activity and remedial action activities.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Water Resources Protection	Part 31of Act, 1994 PA 451. (MCL 324.3104, et seq.) Michigan Administrative Code:R 324.3103, et. seq. ; Part 4: Michigan water quality standards for surface waters to protect public health and welfare, enhance and maintain water quality, and protect the state's natural resources (R 323.1041-1117); Part 5: Spillage of oil and polluting materials addresses spill containment, prevention, clean-up, and reporting (R 323.1158, et. seq.); Part 8: Water quality based effluent limits for toxic chemicals (R 323.1201-1221); Part 9: Wastewater Reporting (R 299.9001, et. seq.); Part 21: Wastewater discharge permits identifies NPDES and State groundwater discharge requirements, including procedures for permit application, permit issuance, and denial (R 323.2106, R 323.2108-9, R 323.2114, R 323.2117-2119, R 323.2128, R 323.2136, R 323.2145, R 323.2149-2151, R 323.2154-2155, R 323.2162-2164, and R 323.2190-2192); Part 22: Groundwater quality rules R 323.2201-2240); Formerly known as Act 245 (1929)	These rules address discharges to both surface waters and groundwater of the State. Regulates water and wastewater discharges with standards for discharge to groundwater. Defines effluent guidelines based on actual water quality, receiving stream properties, and other appropriate water quality criteria. Provides criteria and standards for the National Pollutant Discharge Elimination System (NPDES) and effluent standards for toxic pollutants. This is the implementing statute for the federally delegated NPDES program. Also includes the Industrial Pre-treatment Program (IPP) and Publicly Owned Treatment Works (POTW) requirements.	Yes	Remedial action may result in the discharging of remediated and unremediated contaminated groundwater into waters of the state, i.e., groundwater, surface water, or any other water course. Applicable for remedial alternatives which will treat and/or discharge wastewater to surface waters of the state. Cites specific requirements for the discharge of bioaccumulative chemicals. Discharge requirements can be identified through a substantive requirements document (SRD). Prevents concentrations in surface water of taste and odor producing substances. Prevents acutely and chronically toxic substances from entering surface water based on the LC50 toxicity criteria. Prevents degradation of water quality. Restricts levels of turbidity, color, oil films, floating solids, foams, settling and suspended solids, and deposits.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Sewerage Systems	Part 41of Act, 1994 PA 451. (MCL 324.41, et seq.) Michigan Administrative Code: R 324.4105, et. seq. Formerly known as Act 98 (1913)	Regulates construction and operation of sewerage systems. Requires that treatment facility operators be certified and describes the minimum requirements for certification. The rules prescribe the procedures and requirements for the operation and maintenance of sewerage systems.	Yes	May be applied to treatment systems proposed to discharge treated or untreated effluent to the sewer system
Air Pollution Control	Part 55 of Act, 1994 PA 451. (MCL 324.55, et seq.) Michigan Administrative Code: R 324.5501, R 336.1101, R 336.1123, R 336.1127, R 336.1201-1207, R 336.1209-1229, R 336.1230-1241, R 336.1278-1290, and R 336.1299 (Part 2 Air Use Approval), R 336.1301-1331, R 336.1370-1372 (Part 3 Emissions Limitations & Prohibitions), R 336.1701–1702 (Part 7 Emissions Limitations and Prohibitions- New Sources of Volatile Organic Compound Emissions), R 336.1901, R 336.2001–2007, et. seq. Formerly known as Act 348 (1965)	Requires permitting for air emission sources and air monitoring during activities that may cause contaminant releases to air. Prohibits the emissions of air contaminants from wastes on site in quantities, which cause injurious effects to human health, animal life, plant life of significant economic value, and/or property.	Yes	Applicable for remedial alternatives that generate air emissions
Soil Erosion and Sedimentation Control	Part 91of Act, 1994 PA 451. (MCL 324.9101, et seq.) Michigan Administrative Code: R 323.1701, et. seq. Formerly known as Act 347 (1972)	Requires a soil erosion control and sedimentation plan for any earth changes of one or more acres and/or any earth changes within 500 feet of a lake or stream. Establishes rules prescribing soil erosion and sedimentation control plans, procedures, and measures	Yes	If construction within 500 feet of Grand River is required.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Hazardous Waste Management	Part 111 of Act, 1994 PA 451. (MCL 324.111, et seq.) Michigan Administrative Code: R 299.9202-9208, R 299.9212, R 299.9228, R 299.9301-9312, R 299.9401-9413, R 299.9501-9523, R 299.9601-9634, R 299.9701-9713, R 299.9801-9816, R 299.11001-11008, et. seq. Part 1: General Provisions; Part 2: Identification and Listing of Hazardous Waste; Part 3: Generators of Hazardous Waste; Part 4: Transporters of Hazardous Waste; Part 5: Construction Permits and Operating Licenses; Part 6: Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Part 7: Financial Capability; Part 8: Management of Specific Hazardous Wastes, Specific Types of Hazardous Waste Management Facilities, and Used Oil; Part 9: Hazardous Waste Service Fund; and Part 10: Availability of Referenced Materials. Formerly known as Act 64 (1979)	Defines hazardous waste and establishes requirements for hazardous waste generators, transporters, and for owners and operators of treatment/storage/disposal facilities. Regulates the generation, transport, treatment, storage, and disposal of hazardous wastes from site remediation. Regulates closure, post-closure, and corrective action for hazardous waste treatment, storage and disposal facilities	Yes	Remedial action may generate hazardous waste and involve management of hazardous waste. May be applied to off-site disposal of hazardous waste. Used for determining how and in what type of disposal facility contaminated media may be removed to. May be applied to construction and operation of on-site treatment, storage or disposal units relative to requirements for characterization and handling of hazardous waste. Applied to the excavation of certain contaminated media May be applicable to remedial actions in landfills and in the construction of landfill cells.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Solid Waste Management	Part 115 of Act, 1994 PA 451. (MCL 324.115, et seq.) Michigan Administrative Code: R 324.11501, et. seq. Formerly known as Act 641 (1978)	Addresses solid waste management including general landfill design requirements as promulgated in the administrative rules of the Michigan Solid Waste Management Regulations. Regulates the construction and operation of sanitary landfills, solid waste transfer facilities, and solid waste processing plants. Specifies liner and capping requirements for solid waste landfills. Requirements for the operation and closure of non-hazardous waste treatment, storage, and disposal and groundwater quality performance standards. Also imposes geographic limitations on where non-hazardous solid waste can be disposed.	Yes	Regulates the disposal of non-hazardous solid waste. Provides requirements for closure and post-closure of non-hazardous solid waste treatment, storage and disposal facilities. Provides groundwater quality performance standards. Remedial action may produce non-hazardous solid waste, which must be disposed of in accordance with Part 115. Used for determining the process and type of disposal facility that solid waste or contaminated media may be removed to. May apply to closure (capping) of a landfill. May serve as a basis of design for containment of non-hazardous solid waste on-site.
Liquid Industrial Wastes	Part 121of Act, 1994 PA 451. (MCL 324.121, et seq.) Michigan Administrative Code: R 324.12101, et. seq. Formerly known as Act 136 (1969)	Regulates liquid industrial waste generators, transporters and designated facilities. Transporters are required to be registered and permitted in accordance with the hazardous materials transportation act. Requires a registered and permitted liquid industrial waste transporter to remove any liquid waste off-site. Records are required to be kept by those who generate such waste, under Section 3a. Liquid industrial waste is defined as "any liquid waste, other than unpolluted water."	Yes	Remedial action may require the storage transportation and disposal of liquid industrial wastes. Applies to the on and o site management of liquid industrial wastes. Polluted groundwater or surface water may be generated from a remedial activity.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
PCB Compounds	Part 147 of Act, 1994 PA 451. (MCL 299.3301, et. seq.) Michigan Administrative Code: R 299.5101, et. seq. Formerly known as Act 60 (1976)	Regulates the storage, handling, transporting and disposal of PCBs or PCB contaminated materials. Requirements for notifying the MDEQ of the intent to use, sell, or manufacture PCBs or PCB products. Requirements for annual reporting, exemptions and exclusions, and labeling, as well as provisions for the storage, handling, transportation, and disposal of PCBs or PCB-	No	No PCB compounds have been detected at the site.
Environmental Remediation	Part 201of Act, 1994 PA 451. (MCL 324.201, et seq.) Michigan Administrative Code: R 299.5109, R 299.5505; R 299.5511, R 299.5513, R 299.5515, R 299.5519, R 299.55601, et. seq. Formerly known as Act 307 (1982)	In part, protects the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; and to prescribe the powers and duties of certain state and local agencies and officials.	Yes	Applies to response activities taken at sites of environmental contamination which are facilities as that term is defined in Section 20101(o) of Act 451. Provides risk based site cleanup criteria based on land-use, and other factors necessary to protect the public health, safety, welfare and the environment.
Underground Storage Tank Regulations	Part 211of Act, 1994 PA 451. (MCL 324.211, et seq.) Michigan Administrative Code: R 29.2103, et. seq.	Provides technical standards for underground storage tank (UST) systems including corrosion protection, release detection, spills and overfill protection, and compliance reporting schedules.	No	No underground storage tanks will be used at the site.
Leaking Underground Storage Tanks	Part 213 of Act 1994 PA 451. (MCL 324.213, et seq.) Michigan Administrative Code: R 324.21301a, et. seq.	Regulates and provides for corrective action due to releases from leaking underground storage tank systems. Prescribes the powers and duties of certain state agencies and officials; and provides for penalties and remedies. Also regulates the inspection, abandonment, replacement and installation of underground storage tanks.	No	No underground storage tanks were used at the site.

TABLE A-6
State Action-Specfic ARARs
Ionia City Landfill

STANDARD, REQUIREMENTS, CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/ RELEVANT AND APPROPRIATE	COMMENT
Natural Rivers	Part 305 of Act, 1994 PA 451. (MCL 324.305, et seq.) Michigan Administrative Code: R 324.30501, et. seq. Formerly known as Act 231 (1970)	Regulates activities within 500 feet of a designated natural river. The purpose of these zoning rules is to promote public health and prevent ecological damage due to unwise development or construction within a natural river district. The rules also protect the free-flowing conditions, fish and wildlife, water quality, and recreational values of natural rivers and adjoining land.	Yes	Remedial action may take place within 500 feet of the Grand River.
Dam Safety	Part 315 of Act, 1994 PA 451. (MCL 324.31501, et. seq.) Michigan Administrative Code: R 281.1301, et. seq.	Regulates dam and/or surface water impoundment structures at or greater than 6 feet in height.	No	There are no dams or impoundments on or near the site.
Endangered Species Protection	Part 365 of Act, 1994 PA 451. (MCL 324.365, et seq.) Michigan Administrative Code: R 324.36501, et. seq. Formerly known as Act 203	Establishes rules to provide for conservation, management, enhancement, and protection of species either endangered or threatened with extinction.	Yes	Remedial action may take place and adversely impact endangered species and other habitat
Supervisor of Wells	Part 615 of Act, 1994 PA 451. (MCL 324.615, et seq.) Michigan Administrative Code: R 324.61501, et. seq. Formerly known as Act 61 (1939)	Requires that a permit be obtained prior to drilling oil, gas, brine disposal, and deep well injection wells. Regulates the drilling requirements, which includes well construction, inspection, plugging and abandonment.	No	No remedial actions utilizing deep well disposal or injection is applicable for the site.

Cost Tables

[THE INFORMATION IN THE COST ESTIMATE TABLES ARE BASED ON THE BEST AVAILABLE INFORMATION REGARDING THE ANTICIPATED SCOPE OF THE REMEDIAL ALTERNATIVES. CHANGES IN THE COST ELEMENTS ARE LIKELY TO OCCUR AS A RESULT OF NEW INFORMATION AND DATA COLLECTED DURING DESIGN OR IMPLEMENTATION OF THE REMEDY. MAJOR CHANGES MAY BE DOCUMENTED IN THE FORM OF A MEMORANDUM IN THE ADMINISTRATIVE RECORD FILE, AN ESD, OR A ROD AMENDMENT. THESE ARE ORDER-OF-MAGNITUDE ESTIMATES THAT ARE EXPECTED TO BE WITHIN +50 TO -30 PERCENT OF THE ACTUAL PROJECT COST.]

GROUNDWATER ALTERNATIVE 2 - TABLE 1 OF 3
IONIA CITY L/F -- GROUNDWATER MEASURE INSTITUTIONAL CONTROLS

Description	Qty	Unit	Unit Cost	Total	Reference
Capital Costs					
Deed recording	1	Each	$2,000.00	$2,000	
Initial Monitor Well Sampling/Reporting	1	Each	$15,000.00	$15,000	
Subtotal Capital Costs				**$17,000**	
Contingencies (15% of Capital Cost)				**$2,550**	
Engineering/General Conditions (25% of Capital Costs)				**$4,250**	
TOTAL CAPITAL COSTS				**$23,800**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 2 - TABLE 1 OF 3
IONIA CITY L/F -- GROUNDWATER MEASURE INSTITUTIONAL CONTROLS (Cont'd)

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Yearly O&M Costs					
Semi-Annual Monitor Well Sampling/Reporting	2	Each	$15,000.00	$30,000	
Subtotal Yearly O&M				**$30,000**	
Contingencies (15%)				**$4,500**	
Engineering/Project Management (20% of yearly O&M)				**$6,000**	
TOTAL YEARLY O&M				**$40,500**	
Present Worth (30 year, 7% discount factor)				**$526,400**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 2 - TABLE 3 OF 3

PRESENT WORTH

GROUNDWATER MEASURE INSTITUTIONAL CONTROLS

CAPITAL COST	$23,800
YEARLY O&M COST	$40,500
DISCOUNT RATE	7%

YEAR	DISCOUNT RATE	EXPENDITURE	PRESENT WORTH	TOTAL PRESENT WORTH
0	1.0000	$23,800	$23,800	$23,800
1	0.9346	$40,500	$37,850	$61,650
2	0.8734	$40,500	$35,374	$97,025
3	0.8163	$40,500	$33,060	$130,085
4	0.7629	$40,500	$30,897	$160,982
5	0.7130	$40,500	$28,876	$189,858
6	0.6663	$40,500	$26,987	$216,845
7	0.6227	$40,500	$25,221	$242,066
8	0.5820	$40,500	$23,571	$265,638
9	0.5439	$40,500	$22,029	$287,667
10	0.5083	$40,500	$20,588	$308,255
11	0.4751	$40,500	$19,241	$327,496
12	0.4440	$40,500	$17,982	$345,479
13	0.4150	$40,500	$16,806	$362,285
14	0.3878	$40,500	$15,707	$377,991
15	0.3624	$40,500	$14,679	$392,671
16	0.3387	$40,500	$13,719	$406,389
17	0.3166	$40,500	$12,821	$419,211
18	0.2959	$40,500	$11,982	$431,193
19	0.2765	$40,500	$11,199	$442,392
20	0.2584	$40,500	$10,466	$452,858
21	0.2415	$40,500	$9,781	$462,639
22	0.2257	$40,500	$9,141	$471,780
23	0.2109	$40,500	$8,543	$480,324
24	0.1971	$40,500	$7,984	$488,308
25	0.1842	$40,500	$7,462	$495,770
26	0.1722	$40,500	$6,974	$502,744
27	0.1609	$40,500	$6,518	$509,262
28	0.1504	$40,500	$6,091	$515,353
29	0.1406	$40,500	$5,693	$521,046
30	0.1314	$40,500	$5,320	$526,366

GROUNDWATER ALTERNATIVE 3 - TABLE 1 OF 3
IONIA CITY L/F -- MONITORED NATURAL ATTENUATION

Description	Qty	Unit	Unit Cost	Total	Reference
Capital Costs					
MNA Study	1	Each	$34,140.00	$34,140	
Rcvy Well Installation, 6" SS screen & riser, Bumper posts	3	Each	$8,400.00	$25,200	Stearns Drilling
Subtotal Capital Costs				**$59,340**	
Contingencies (15% of Capital Cost)				**$8,901**	
Engineering/General Conditions (20% of Capital Costs)				**$11,868**	
TOTAL CAPITAL COSTS				**$80,109**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 3 - TABLE 2 OF 3
IONIA CITY L/F -- MONITORED NATURAL ATTENUATION (Cont'd)

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Yearly O&M Costs					
Yearly MNA sampling,analysis,data evaul, report	1	Each	$34,140.00	$34,140	
Subtotal Yearly O&M				**$34,140**	
Contingencies (15%)				**$5,121**	
Engineering/Project Management (20% of yearly O&M)				**$6,828**	
TOTAL YEARLY O&M				**$46,089**	
Present Worth (30 year, 7% discount factor)				**$652,000**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

PRESENT WORTH

GROUNDWATER ALTERNATIVE 3 - TABLE 3 OF 3

MONITORED NATURAL ATTENUATION

CAPITAL COST	$80,100
YEARLY O&M COST	$46,100
DISCOUNT RATE	7%

YEAR	DISCOUNT RATE	EXPENDITURE	PRESENT WORTH	TOTAL PRESENT WORTH
0	1.0000	$80,100	$80,100	$80,100
1	0.9346	$46,100	$43,084	$123,184
2	0.8734	$46,100	$40,266	$163,450
3	0.8163	$46,100	$37,631	$201,081
4	0.7629	$46,100	$35,169	$236,250
5	0.7130	$46,100	$32,869	$269,119
6	0.6663	$46,100	$30,718	$299,837
7	0.6227	$46,100	$28,709	$328,546
8	0.5820	$46,100	$26,831	$355,377
9	0.5439	$46,100	$25,075	$380,452
10	0.5083	$46,100	$23,435	$403,887
11	0.4751	$46,100	$21,902	$425,789
12	0.4440	$46,100	$20,469	$446,258
13	0.4150	$46,100	$19,130	$465,388
14	0.3878	$46,100	$17,878	$483,266
15	0.3624	$46,100	$16,709	$499,975
16	0.3387	$46,100	$15,616	$515,591
17	0.3166	$46,100	$14,594	$530,185
18	0.2959	$46,100	$13,639	$543,824
19	0.2765	$46,100	$12,747	$556,571
20	0.2584	$46,100	$11,913	$568,484
21	0.2415	$46,100	$11,134	$579,618
22	0.2257	$46,100	$10,405	$590,023
23	0.2109	$46,100	$9,725	$599,748
24	0.1971	$46,100	$9,088	$608,836
25	0.1842	$46,100	$8,494	$617,330
26	0.1722	$46,100	$7,938	$625,268
27	0.1609	$46,100	$7,419	$632,687
28	0.1504	$46,100	$6,934	$639,621
29	0.1406	$46,100	$6,480	$646,101
30	0.1314	$46,100	$6,056	$652,157

GROUNDWATER ALTERNATIVE 4 - TABLE 1 OF 3
IONIA CITY L/F -- GROUNDWATER EXTRACTION DISCHARGE TO SURFACE WATER

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Capital Costs					
Rcvy Well Installation, 6" SS screen & Riser, Bumper posts	0	Each	$8,400.00	$0	Stearns Drilling
Pump and Pitless Installation	0	Each	$3,000.00	$0	Stearns Drilling
Trenching/Pipe Installation, System Bldg, Controls	0	LS	$44,490.00	$0	Great Lakes Carbon
Outfall Installation	1	LS	$2,000.00	$2,000	12.3 750 2000[1]
Load/transport/disposal non-haz trench spoils	0	C.Y.	$50.00	$0	
Load/transport/disposal haz trench spoils	0	C.Y.	$125.00	$0	
Subtotal Capital Costs				**$2,000**	
Start-up/Shake-down (10% of Capital Costs)				**$200**	
Contingencies (15% of Capital Costs)				**$300**	
Engineering/General Conditions (15% of Capital Costs)				**$300**	
TOTAL CAPITAL COSTS				**$2,800**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 4 - TABLE 2 OF 3
IONIA CITY L/F --GROUNDWATER EXTRACTION DISCHARGE TO SURFACE WATER (Cont'd)

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Yearly O&M Costs					
System influent/effluent sampling/analysis/reporting	12	Each	$2,500.00	$30,000	
Semi-annual monitor well sampling/analysis/reporting	2	Each	$15,000.00	$30,000	
Semi-annual well/pipeline cleaning	2	Each	$6,000.00	$12,000	Stearns Drilling
Utility charges	9,800	KwH	$0.07	$686	
Repair Parts (2% of Capital Costs)	1	LS	$2,940.00	$2,940	
Subtotal Yearly O&M				**$75,626**	
Contingencies (15%)				**$11,344**	
Engineering/Project Management (20% of yearly O&M)				**$15,125**	
TOTAL YEARLY O&M				**$102,095**	
Present Worth (30 year, 7% discount factor)				**$1,269,763**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 4 - TABLE 3 OF 3

PRESENT WORTH

GROUNDWATER EXTRACTION & DISCHAGE TO SURFACE

CAPITAL COST	$2,800
YEARLY O&M COST	$102,100
DISCOUNT RATE	7%

YEAR	DISCOUNT RATE	EXPENDITURE	PRESENT WORTH	TOTAL PRESENT WORTH
0	1.0000	$2,800	$2,800	$2,800
1	0.9346	$102,100	$95,421	$98,221
2	0.8734	$102,100	$89,178	$187,399
3	0.8163	$102,100	$83,344	$270,743
4	0.7629	$102,100	$77,892	$348,634
5	0.7130	$102,100	$72,796	$421,430
6	0.6663	$102,100	$68,034	$489,464
7	0.6227	$102,100	$63,583	$553,046
8	0.5820	$102,100	$59,423	$612,470
9	0.5439	$102,100	$55,536	$668,005
10	0.5083	$102,100	$51,902	$719,908
11	0.4751	$102,100	$48,507	$768,415
12	0.4440	$102,100	$45,334	$813,748
13	0.4150	$102,100	$42,368	$856,116
14	0.3878	$102,100	$39,596	$895,712
15	0.3624	$102,100	$37,006	$932,718
16	0.3387	$102,100	$34,585	$967,303
17	0.3166	$102,100	$32,322	$999,625
18	0.2959	$102,100	$30,208	$1,029,833
19	0.2765	$102,100	$28,232	$1,058,064
20	0.2584	$102,100	$26,385	$1,084,449
21	0.2415	$102,100	$24,658	$1,109,107
22	0.2257	$102,100	$23,045	$1,132,153
23	0.2109	$102,100	$21,538	$1,153,690
24	0.1971	$102,100	$20,129	$1,173,819
25	0.1842	$102,100	$18,812	$1,192,631
26	0.1722	$102,100	$17,581	$1,210,212
27	0.1609	$102,100	$16,431	$1,226,643
28	0.1504	$102,100	$15,356	$1,241,999
29	0.1406	$102,100	$14,351	$1,256,351
30	0.1314	$102,100	$13,413	$1,269,763

GROUNDWATER ALTERNATIVE 5 - TABLE 1 OF 3
IONIA CITY L/F -- GROUNDWATER EXTRACTION DISCHARGE TO POTW

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Capital Costs					
Rcvy Well Installation, 6" SS screen & Riser, Bumper posts	0	Each	$8,400.00	$0	Stearns Drilling
Pump and Pitless Installation	0	Each	$3,000.00	$0	Stearns Drilling
Trenching/Pipe Installation, System Bldg, Controls	0	LS	$44,490.00	$0	Great Lakes Carbon
Load/transport/disposal non-haz trench spoils	0	C.Y.	$50.00	$0	
Load/transport/disposal haz trench spoils	0	C.Y.	$125.00	$0	
Subtotal Capital Costs				**$0**	
Start-up/Shake-down (10% of Capital Costs)				**$0**	
Contingencies (15% of Capital Costs)				**$0**	
Engineering/General Conditions (15% of Capital Costs)				**$0**	
TOTAL CAPITAL COSTS				**$0**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 5 - TABLE 2 OF 3
IONIA CITY L/F --GROUNDWATER EXTRACTION DISCHARGE TO POTW (Cont'd)

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Yearly O&M Costs					
Monthly influent/effluent sampling/analysis/reporting	12	Each	$2,500.00	$30,000	
Semi-annual monitor well sampling/analysis/reporting	2	Each	$15,000.00	$30,000	
Semi-annual well/pipeline cleaning	2	Each	$6,000.00	$12,000	Stearns Drilling
Utility charges	9,800	KwH	$0.07	$686	
Repair Parts (2% of Capital Costs)	1	LS	$2,880.00	$2,880	
Subtotal Yearly O&M				**$75,566**	
Contingencies (15%)				**$11,335**	
Engineering/Project Management (20% of yearly O&M)				**$15,113**	
TOTAL YEARLY O&M				**$102,014**	
Present Worth (30 year, 7% discount factor)				**$1,265,722**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 5 - TABLE 3 OF 3

PRESENT WORTH

GROUNDWATER EXTRACTION & DISCHAGE TO POTW

CAPITAL COST	$0
YEARLY O&M COST	$102,000
DISCOUNT RATE	7%

YEAR	DISCOUNT RATE	EXPENDITURE	PRESENT WORTH	TOTAL PRESENT WORTH
0	1.0000	$0	$0	$0
1	0.9346	$102,000	$95,327	$95,327
2	0.8734	$102,000	$89,091	$184,418
3	0.8163	$102,000	$83,262	$267,680
4	0.7629	$102,000	$77,815	$345,496
5	0.7130	$102,000	$72,725	$418,220
6	0.6663	$102,000	$67,967	$486,187
7	0.6227	$102,000	$63,520	$549,708
8	0.5820	$102,000	$59,365	$609,072
9	0.5439	$102,000	$55,481	$664,554
10	0.5083	$102,000	$51,852	$716,405
11	0.4751	$102,000	$48,459	$764,865
12	0.4440	$102,000	$45,289	$810,154
13	0.4150	$102,000	$42,326	$852,480
14	0.3878	$102,000	$39,557	$892,038
15	0.3624	$102,000	$36,969	$929,007
16	0.3387	$102,000	$34,551	$963,558
17	0.3166	$102,000	$32,291	$995,849
18	0.2959	$102,000	$30,178	$1,026,027
19	0.2765	$102,000	$28,204	$1,054,231
20	0.2584	$102,000	$26,359	$1,080,589
21	0.2415	$102,000	$24,634	$1,105,224
22	0.2257	$102,000	$23,023	$1,128,247
23	0.2109	$102,000	$21,517	$1,149,763
24	0.1971	$102,000	$20,109	$1,169,872
25	0.1842	$102,000	$18,793	$1,188,665
26	0.1722	$102,000	$17,564	$1,206,229
27	0.1609	$102,000	$16,415	$1,222,644
28	0.1504	$102,000	$15,341	$1,237,985
29	0.1406	$102,000	$14,337	$1,252,323
30	0.1314	$102,000	$13,399	$1,265,722

GROUNDWATER ALTERNATIVE 6 - TABLE 1 OF 3
IONIA CITY L/F -- AIR STRIPPING

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Capital Costs					
Rcvy Well Installation, 6" SS screen & Riser, Bumper posts	0	Each	$8,400.00	$0	Stearns Drilling
Pump and Pitless Installation	0	Each	$3,000.00	$0	Stearns Drilling
30 Gpm Air Stripper, Trenching/Pipe Installation, Treatment Bldg, Controls	0	LS	$75,000.00	$0	Great Lakes Carbon
Load/transport/disposal non-haz trench spoils	0	C.Y.	$50.00	$0	
Load/transport/disposal haz trench spoils	0	C.Y.	$125.00	$0	
Subtotal Capital Costs				**$0**	
Start-up/Shake-down (20% of Capital Costs)				**$0**	
Contingencies (15% of Capital Costs)				**$0**	
Engineering/General Conditions (25% of Capital Costs)				**$0**	
TOTAL CAPITAL COSTS				**$0**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 6 - TABLE 2 OF 3
IONIA CITY L/F -- AIR STRIPPING (Cont'd)

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Yearly O&M Costs					
Monthly influent/effluent sampling/analysis/reporting	12	Each	$2,500.00	$30,000	
Semi-annual monitor well sampling/analysis/reporting	2	Each	$15,000.00	$30,000	
Semi-annual well/pipeline cleaning	2	Each	$6,000.00	$12,000	Stearns Drilling
Utilitiy charges	49,000	KwH	$0.07	$3,430	
Repair Parts (2% of Capital Costs)	1	LS	$4,300.00	$4,300	
Subtotal Yearly O&M				**$79,730**	
Contingencies (15%)				**$11,960**	
Engineering/Project Management (20% of yearly O&M)				**$15,946**	
TOTAL YEARLY O&M				**$107,636**	
Present Worth (30 year, 7% discount factor)				**$1,335,213**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 6 - TABLE 3 OF 3

PRESENT WORTH
AIR STRIPPING

CAPITAL COST	$0
YEARLY O&M COST	$107,600
DISCOUNT RATE	7%

YEAR	DISCOUNT RATE	EXPENDITURE	PRESENT WORTH	TOTAL PRESENT WORTH
0	1.0000	$0	$0	$0
1	0.9346	$107,600	$100,561	$100,561
2	0.8734	$107,600	$93,982	$194,543
3	0.8163	$107,600	$87,834	$282,376
4	0.7629	$107,600	$82,088	$364,464
5	0.7130	$107,600	$76,717	$441,181
6	0.6663	$107,600	$71,698	$512,880
7	0.6227	$107,600	$67,008	$579,888
8	0.5820	$107,600	$62,624	$642,512
9	0.5439	$107,600	$58,527	$701,039
10	0.5083	$107,600	$54,698	$755,737
11	0.4751	$107,600	$51,120	$806,857
12	0.4440	$107,600	$47,776	$854,633
13	0.4150	$107,600	$44,650	$899,283
14	0.3878	$107,600	$41,729	$941,012
15	0.3624	$107,600	$38,999	$980,012
16	0.3387	$107,600	$36,448	$1,016,459
17	0.3166	$107,600	$34,063	$1,050,523
18	0.2959	$107,600	$31,835	$1,082,358
19	0.2765	$107,600	$29,752	$1,112,110
20	0.2584	$107,600	$27,806	$1,139,916
21	0.2415	$107,600	$25,987	$1,165,903
22	0.2257	$107,600	$24,287	$1,190,189
23	0.2109	$107,600	$22,698	$1,212,887
24	0.1971	$107,600	$21,213	$1,234,100
25	0.1842	$107,600	$19,825	$1,253,926
26	0.1722	$107,600	$18,528	$1,272,454
27	0.1609	$107,600	$17,316	$1,289,770
28	0.1504	$107,600	$16,183	$1,305,953
29	0.1406	$107,600	$15,125	$1,321,078
30	0.1314	$107,600	$14,135	$1,335,213

GROUNDWATER ALTERNATIVE 7 - TABLE 1 OF 3
IONIA CITY L/F -- CARBON ADSORPTION

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Capital Costs					
Rcvy Well Installation, 6" SS screen & Riser, Bumper posts	0	Each	$8,400.00	$0	Stearns Drilling
Pump and Pitless Installation	0	Each	$3,000.00	$0	Stearns Drilling
35 gpm Dual-bed Carbon Adsorption Unit, Trenching/Pipe Installation, Treatment	0	LS	$1.23	$0	Great Lakes Carbon
Initial Charge of Carbon	1,320	LB	$1.23	$1,624	
Load/transport/disposal non-haz trench spoils	0	C.Y.	$50.00	$0	
Load/transport/disposal haz trench spoils	0	C.Y.	$125.00	$0	
Subtotal Capital Costs				**$1,624**	
Start-up/Shake-down (20% of Capital Costs)				**$325**	
Contingencies (15% of Capital Costs)				**$244**	
Engineering/General Conditions (25% of Capital Costs)				**$406**	
TOTAL CAPITAL COSTS				**$2,598**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 7 - TABLE 2 OF 3
IONIA CITY L/F -- CARBON ADSORPTION (Cont'd)

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Yearly O&M Costs					
Monthly influent/effluent sampling/analysis/reporting	12	Each	$2,500.00	$30,000	
Semi-annual monitor well sampling/analysis/reporting	2	Each	$15,000.00	$30,000	
Semi-annual well/pipeline cleaning	2	Each	$6,000.00	$12,000	Stearns Drilling
Utility charges	22,000	KwH	$0.07	$1,540	
Carbon replacement/RegenrationDisposal	2,640	LB	$1.79	$4,726	
Repair Parts (2% of Capital Costs)	1	LS	$4,300.00	$4,300	
Subtotal Yearly O&M				**$82,566**	
Contingencies (15%)				**$12,385**	
Engineering/Project Management (20% of yearly O&M)				**$16,513**	
TOTAL YEARLY O&M				**$111,464**	
Present Worth (30 year, 7% discount factor)				**$1,386,206**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

GROUNDWATER ALTERNATIVE 7 - TABLE 3 OF 3
PRESENT WORTH
CARBON TREATMENT

CAPITAL COST	$2,598
YEARLY O&M COST	$111,500
DISCOUNT RATE	7%

YEAR	DISCOUNT RATE	EXPENDITURE	PRESENT WORTH	TOTAL PRESENT WORTH
0	1.0000	$2,598	$2,598	$2,598
1	0.9346	$111,500	$104,206	$106,804
2	0.8734	$111,500	$97,388	$204,192
3	0.8163	$111,500	$91,017	$295,209
4	0.7629	$111,500	$85,063	$380,272
5	0.7130	$111,500	$79,498	$459,770
6	0.6663	$111,500	$74,297	$534,067
7	0.6227	$111,500	$69,437	$603,504
8	0.5820	$111,500	$64,894	$668,398
9	0.5439	$111,500	$60,649	$729,046
10	0.5083	$111,500	$56,681	$785,727
11	0.4751	$111,500	$52,973	$838,700
12	0.4440	$111,500	$49,507	$888,208
13	0.4150	$111,500	$46,269	$934,476
14	0.3878	$111,500	$43,242	$977,718
15	0.3624	$111,500	$40,413	$1,018,130
16	0.3387	$111,500	$37,769	$1,055,899
17	0.3166	$111,500	$35,298	$1,091,197
18	0.2959	$111,500	$32,989	$1,124,186
19	0.2765	$111,500	$30,831	$1,155,017
20	0.2584	$111,500	$28,814	$1,183,831
21	0.2415	$111,500	$26,929	$1,210,759
22	0.2257	$111,500	$25,167	$1,235,926
23	0.2109	$111,500	$23,521	$1,259,447
24	0.1971	$111,500	$21,982	$1,281,429
25	0.1842	$111,500	$20,544	$1,301,973
26	0.1722	$111,500	$19,200	$1,321,172
27	0.1609	$111,500	$17,944	$1,339,116
28	0.1504	$111,500	$16,770	$1,355,886
29	0.1406	$111,500	$15,673	$1,371,559
30	0.1314	$111,500	$14,647	$1,386,206

SELECTED FINAL REMEDY - TABLE 1 OF 3
IONIA CITY L/F -- INSTITUTIONAL CONTROLS, GROUNDWATER EXTRACTION, TREATMENT AND DISCHARGE TO POTW, AND MONITORED NATURAL ATTENUATION

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Capital Costs					
Deed recording	1	Each	$2,000.00	$2,000	
Initial Monitor Well Sampling/Reporting	1	Each	$15,000.00	$15,000	
Initial inspection/upgrades to fence/cover	1	Each	$10,000.00	$10,000	
Rcvy Well Installation, 6" SS screen & Riser, Bumper posts	0	Each	$8,400.00	$0	Stearns Drilling
Pump and Pitless Installation	0	Each	$3,000.00	$0	Stearns Drilling
30 Gpm Air Stripper, Trenching/Pipe Installation, Treatment Bldg, Controls	0	LS	$75,000.00	$0	Great Lakes Carbon
Load/transport/disposal non-haz trench spoils	0	C.Y.	$50.00	$0	
Load/transport/disposal haz trench spoils	0	C.Y.	$125.00	$0	
MNA Study	1	Each	$34,140.00	$34,140	
Monitoring Well Installation, 2" SS screen & riser, Bumper posts	6	Each	$8,400.00	$50,400	Stearns Drilling
Subtotal Capital Costs				**$111,540**	
Start-up/Shake-down (20% of System Capital Costs)				**$0**	
Contingencies (15% of Capital Cost)				**$16,731**	
Engineering/General Conditions (25% of Capital Costs)				**$27,885**	
TOTAL CAPITAL COSTS				**$156,156**	

(1) RS Means, "Site Work & Landscape Cost Data-2000"
(2) RS Means, "Environmental Remediation Cost Data - 2000"

SELECTED FINAL REMEDY - TABLE 2 OF 3
IONIA CITY L/F -- INSTITUTIONAL CONTROLS, GROUNDWATER EXTRACTION, TREATMENT AND DISCHARGE TO POTW, AND MONITORED NATURAL ATTENUATION

Description	Qty	Unit	Unit Cost	Total	Reference/Notes
Yearly O&M Costs					
Quarterly Inspection/report	4	Each	$600.00	$2,400	
Mowing, two times/year	46	Acre	$27.20	$1,251	18 05 0415[2]
Ditch Maintenance	1	Each	$2,500.00	$2,500	
Cap Repairs	1	Each	$2,000.00	$2,000	
Fence/Sign Repairs	1	Each	$1,000.00	$1,000	
Semi-Annual Monitor Well Sampling/Reporting	2	Each	$15,000.00	$30,000	
Sampling/analysis/reporting	12	Each	$2,500.00	$30,000	
Semi-annual well/pipeline cleaning	2	Each	$6,000.00	$12,000	Stearns Drilling
Utility charges	49,000	KwH	$0.07	$3,430	
Repair Parts (2% of Treatment System Capital Costs)	1	LS	$4,300.00	$4,300	
Yearly MNA sampling,analysis,data evaul, report	1	Each	$34,140.00	$34,140	
Subtotal Yearly O&M				**$123,021**	
Contingencies (15%)				**$18,453**	
Engineering/Project Management (20% of yearly O&M)				**$24,604**	
TOTAL YEARLY O&M				**$166,079**	
Present Worth (30 year, 7% discount factor)				**$2,215,901**	

SELECTED FINAL REMEDY - TABLE 2 OF 3

IONIA CITY L/F -- INSTITUTIONAL CONTROLS, EXISTING SOIL COVER, GROUNDWATER EXTRACTION, TREATMENT AND DISCHARGE TO POTW, AND MONITORED NATURAL ATTENUATION

PRESENT WORTH

CAPITAL COST	$156,000
YEARLY O&M COST	$166,000
DISCOUNT RATE	7%

YEAR	DISCOUNT RATE	EXPENDITURE	PRESENT WORTH	TOTAL PRESENT WORTH
0	1.0000	$156,000	$156,000	$156,000
1	0.9346	$166,000	$155,140	$311,140
2	0.8734	$166,000	$144,991	$456,131
3	0.8163	$166,000	$135,505	$591,636
4	0.7629	$166,000	$126,641	$718,277
5	0.7130	$166,000	$118,356	$836,633
6	0.6663	$166,000	$110,613	$947,246
7	0.6227	$166,000	$103,376	$1,050,622
8	0.5820	$166,000	$96,614	$1,147,236
9	0.5439	$166,000	$90,293	$1,237,529
10	0.5083	$166,000	$84,386	$1,321,915
11	0.4751	$166,000	$78,865	$1,400,780
12	0.4440	$166,000	$73,706	$1,474,486
13	0.4150	$166,000	$68,884	$1,543,370
14	0.3878	$166,000	$64,378	$1,607,748
15	0.3624	$166,000	$60,166	$1,667,914
16	0.3387	$166,000	$56,230	$1,724,144
17	0.3166	$166,000	$52,551	$1,776,695
18	0.2959	$166,000	$49,113	$1,825,808
19	0.2765	$166,000	$45,900	$1,871,709
20	0.2584	$166,000	$42,898	$1,914,606
21	0.2415	$166,000	$40,091	$1,954,698
22	0.2257	$166,000	$37,468	$1,992,166
23	0.2109	$166,000	$35,017	$2,027,183
24	0.1971	$166,000	$32,726	$2,059,909
25	0.1842	$166,000	$30,585	$2,090,495
26	0.1722	$166,000	$28,584	$2,119,079
27	0.1609	$166,000	$26,714	$2,145,794
28	0.1504	$166,000	$24,967	$2,170,760
29	0.1406	$166,000	$23,333	$2,194,094
30	0.1314	$166,000	$21,807	$2,215,901

Appendix A - Responsiveness Summary

Ionia City Landfill, Ionia, Michigan
Responsiveness Summary

This summary provides the responses to public comments on the Ionia City Landfill Site Proposed Plan. Each comment is provided with the response below.

The text of these full comments can be found in the U.S. EPA Ionia City Landfill Site Administrative Record. Comments were provided by interested parties during the public comment period which was from July 12, 2000 through September 7, 2000. No verbal comments were made at the public meeting held on July 26, 2000.

Comment No. 1

The hydrogeological characterization of the site indicates that groundwater on the south side of the site vents to the Grand River and the property south of the river will not be impacted by the landfill. This being the case, the City of Ionia believes that the cleanup goal at the Landfill property bounded by the Grand River should be the mixing zone-based GSI criteria only and not the drinking water MCL criteria. - City of Ionia

Response:

The NCP requires that Superfund remedies meet all federal and state ARARs unless waived. In the case of the Ionia City Landfill that means attaining MCLs at the waste boundary which coincides with the property boundary at this site and GSI discharge limits at the Grand River and Kanouse Drain. However, there are two locations where a surface water body and the property boundary co-exist. One is the eastern boundary of Area B (Kanouse Drain) and as noted in the comment the southern boundary of Area B (Grand River).

Neighboring properties and the Grand River are potential sources of drinking water. Through institutional controls, properties to the north, west and east of the site, can be prohibited from installation of drinking water or irrigation wells until MCLs are attained. However, the Grand River cannot be restricted from being used as a drinking water source. A review of US EPA Region 9's Preliminary Remediation Goals (PRGs), based on risk, reveal a vinyl chloride water cleanup level of .02 ug/l which is even more restrictive than MCLs. Until chronic discharge limits can be calculated for the Grand River, MCLs will have to be attained at this boundary.

Comment No. 2

The Proposed Plan calls for collecting and treating groundwater in the point source area - the 500 microgram per liter (ug/l) volatile organic compound (VOC) plume. The City of Ionia requests that EPA include a provision in the Proposed Plan and the ROD requiring containment of the 500 ug/l VOC plume until a demonstration can be made that cleanup goals will continue to be achieved at the landfill property boundaries. This

will provide a basis for shutting down the treatment system at some point in the future, assuming the demonstration can be made. - City of Ionia

Response

The US EPA agrees with the comment and the ROD includes a provision that a demonstration must be made that cleanup goals, i.e., MCLs and GSI discharge limits, will continue to be achieved through natural processes before shutting down the pump and treat system that will contain/treat the 500 ug/l total VOC plume.

Comment No. 3

It appears you have done your homework. The people of Ionia and specifically the people who live in that area did not create the problem. Groundwater Measure Number 6 is in my opinion the best and most effective answer. - Scott Miller, Ionia resident.

Response

Your opinion/recommendation is noted.

Comment No. 4

Alternatives SM-2 and SM-3 ARAR for Part 115. The Proposed Plan only needs to address the groundwater operable unit at the site. Soil and cap issues were addressed in the Operable Unit 1 ROD and removal actions and do not need to be addressed in this action. MDEQ recommends that all references to soil actions are deleted for the remedial alternatives proposed remedy. - MDEQ

Response

U.S. EPA agrees with the comment and has removed references to a soil remedy as part of this final ROD.

Comment No. 5

Relative to Alternative GM-6, the groundwater pump and treat system will be required to meet the performance standard of the Mixing Zone Determination (MZD) Groundwater to Surface Water Interface (GSI) criteria at the Kanouse Drain and Wetland. The term "standard" should be replaced with language "compliant with MZD GSI requirements". MDEQ believes there must be complete capture of the contaminant plume exceeding criteria so there will not be an on-going release to the Kanouse Drain and Wetland above criteria. It is likely the current groundwater extraction system is not completely capturing the plume and it will not be able to draw the plume back from the property boundary. Furthermore, the 500 ug/l total volatile organic chemicals isoplath, while appropriate for an interim action, has no regulatory basis as a final cleanup criterion. The regulatory criteria must be Maximum Cleanup Levels at the property boundary and

GSI criteria at the Kanouse Drain and Wetland. With plume capture to prevent further releases to the drain and beyond the property boundaries and appropriate Institutional Controls on the properties located west, southwest, and southeast of Area A, a Monitored Natural Attenuation remedy is appropriate for the contaminates which have already migrated off site. - MDEQ

Response

There are a number of issues raised in this comment.

1. The term regulatory "standard" should be replaced with "compliant with MZD GSI requirements".

> *The ROD is even more specific than that. It states that MDEQ GSI discharge limits must be attained at the Grand River and Kanouse Drain and the specific chronic and acute limits calculated by MDEQ are shown in the ROD.*

2. MDEQ believes there must be complete capture of the contaminant plume exceeding criteria so there will not be an on-going release to the Kanouse Drain and Wetland above criteria. It is likely the current groundwater extraction system is not completely capturing the plume and it will not be able to draw the plume back from the property boundary.

> *US EPA agrees that the current pump and treat system is not completely capturing the contaminated plume; however, it was never designed to do so. US EPA believes that by capturing the 500 ug/l total VOC isoplath, that natural processes will allow contaminant levels to reach MCLs or GSI discharge limits, where appropriate over time. The NCP states that ARARs, of which the GSI discharge limits are considered one for this site, will be attained at completion of the remedial action. Since MCLs are lower for all contaminants of concern, except for copper, at this site and since the property boundary is either the same as or farther away from the former point source, the GSI discharge limits will likely be attained before federal MCLs. If not, pump and treat and monitored natural attenuation will continue until GSI discharge limits are attained which meet the ARAR requirement.*
>
> *Secondly, except for vinyl chloride, all other contaminants of concern are <u>not</u> currently exceeding either the chronic or acute discharge limits based on the most recent groundwater sampling in February 1999. In addition, this groundwater sampling event occurred prior to start up of the pump and treat system. Taking a closer look at the chronic discharge limit of 15 ug/l for vinyl chloride reveals that its basis is in human health protection. An ecologically protective discharge limit for vinyl chloride is 930 ug/l based on the revised Mixing Zone Determination dated September 14, 2000. State regulations require*

selection of the more stringent of the health protection thresholds; however, from a reasonable future use perspective, the Kanouse Drain does not supply sufficient water to be considered as a potential drinking water source or represent an excess human health risk. The ecological system in and adjacent to the Kanouse Drain are more practical benchmarks for evaluating adverse impacts due to continuing discharges of vinyl chloride to the Kanouse Drain. According to the revised Mixing Zone Determination, vinyl chloride has a limit of 930 ug/l, or nearly 4.5 times greater than the highest concentrations found near the Kanouse Drain before the pump and treat system was operating.

Therefore, U.S. EPA believes that capture of the 500 ug/l plume and natural processes to reduce contaminants, particularly vinyl chloride near the Kanouse Drain, over time will be protective of human health and the environment.

3. The 500 ug/l total volatile organic chemicals isoplath, while appropriate for an interim action, has no regulatory basis as a final cleanup criterion. The regulatory criteria must be Maximum Cleanup Levels at the property boundary and GSI criteria at the Kanouse Drain and Wetland.

US EPA agrees that capture of the 500 ug/l total VOC isoplath is not based on any specific regulation. MCLs and GSI discharge criteria are the contaminant levels that must be attained, as appropriate, in the final groundwater remedy for the site. However, US EPA believes that it is still critical to capture the 500 ug/l isoplath since its capture will result in the capture of all of the TCE, and the vast majority of cis-DCE and vinyl chloride near the former source area. Although an elementary approach, the BIOCHLOR model run by a consultant to US EPA demonstrated that through capture of the 500 ug/l isoplath that natural attenuation processes would be successful in attaining MCLs over time and meeting the long-term objectives of the remedy.

4. With plume capture to prevent further releases to the drain and beyond the property boundaries and appropriate Institutional Controls on the properties located west, southwest, and southeast of Area A, a Monitored Natural Attenuation remedy is appropriate for the contaminants which have already migrated off site.

US EPA believes that attaining GSI discharge limits and MCLs over time and appropriate Institutional Controls west, southwest and southeast of Area A will allow natural processes to reduce contaminant levels that have already migrated off site and is appropriate for this site.

Comment No. 6

In order to demonstrate capture, a groundwater monitoring network must be established in the beginning of the Operation and Maintenance period. A contingency plan for enhancement of the extraction system should also be included in the remedy in case the monitoring program demonstrates that adequate plume capture is not occurring. A reasonable monitoring period prior to making a decision concerning capture would be quarterly monitoring for a period of one year. - MDEQ

Response

The final groundwater remedy states that,

> *Periodic draw-down measurements and sampling of monitoring wells installed down-gradient from the recovery wells will be required to verify the effectiveness and adequacy of the recovery well network in containing/treating the 500 µg/l total VOC plume and achieving and sustaining federal MCLs at the waste boundary through natural processes over time and MDEQ GSI discharge limits at the Grand River and Kanouse Drain over time. Recovery of contaminated groundwater may involve modifications to contain and treat the 500 µg/l total VOC plume and achieve and sustain MCLs and GSI discharge limits if monitoring indicates that the existing system is insufficient.*

The adequacy of plume capture will be an ongoing process, not limited to just the first year and at a minimum of every five years as part of the Five Year Review process. In addition, approaches to establishing a baseline for evaluating natural attenuation generally include two years of quarterly monitoring. This approach should not only be sufficient for establishing the baseline for monitored natural attenuation, but also should give US EPA a very good idea of the current pump and treat system's capture. US EPA envisions that after the ROD is signed the PRPs will begin developing an Operation and Maintenance Plan for the site that includes not only a contingency plan for evaluation and modifications of the existing system but will also describe all aspects of the long-term monitoring necessary to adequately evaluate attainment of MCLs and GSI discharge limits.

Appendix B - State Letter of Non-Concurrence

STATE OF MICHIGAN

JOHN ENGLER, Governor
DEPARTMENT OF ENVIRONMENTAL QUALITY
"Better Service for a Better Environment"
HOLLISTER BUILDING, PO BOX 30473, LANSING MI 48909-7973
INTERNET: www.deq.state.mi.us
RUSSELL J. HARDING, Director

November 22, 2000

Mr. William E. Muno, Director
Superfund Division
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard (S-6J)
Chicago, Illinois 60604-3590

Dear Mr. Muno:

Staff of the Michigan Department of Environmental Quality (MDEQ) has reviewed the Record of Decision (ROD) for the Groundwater Component, signed September 28, 2000, for the Ionia City Landfill site in Ionia County, Michigan. The MDEQ regrets that it is unable to concur with the United States Environmental Protection Agency's (U.S. EPA) remedy because it is not compliant with federal and state laws. The remedy would utilize the pump and treat system installed during a previous removal action, which is currently in operation on the site and relies on monitored natural attenuation to eventually (perhaps in 30 years) meet the criteria for the groundwater discharging to waters of the state and maximum contaminant levels (MCLs) for groundwater beyond the capture zone of the current system.

The remedy, as currently proposed, will not meet state cleanup requirements for capturing the on-site plume in a manner to halt the continued migration of groundwater above the MCLs beyond the boundary of the property with use restrictions to the north, west, and east of the site; and mixing zone-based Groundwater to Surface Water Interface criteria prior to discharge to the Kanouse Drain and Wetland, located adjacent to and east of the site. We believe that enhancements to the current on-site pump and treat system, monitoring program and use restrictions could have been incorporated in remedy implementation in order to meet the state's applicable cleanup criteria.

The MDEQ is willing to continue to work with your agency to implement a remedy that achieves the groundwater cleanup criteria in a timely manner. If you have any questions, please contact Ms. Cindy Fairbanks, Superfund Section, Environmental Response Division, at 517-335-4111, or you may contact me.

Sincerely,

Russell J. Harding
Director
517-373-7917

cc: Mr. Thomas Short, U.S. EPA
Ms. Wendy Carney, U.S. EPA
Mr. Alan J. Howard, MDEQ
Ms. Claudia L.S. Kerbawy, MDEQ
Dr. George Carpenter, MDEQ
Ms. Cindy Fairbanks, MDEQ

Appendix C - Administrative Record Index

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
IONIA CITY LANDFILL
IONIA, IONIA COUNTY, MICHIGAN

UPDATE #4
SEPTEMBER 28, 2000

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	09/19/00	Fairbanks, C., MDEQ	Short, T., U.S. EPA	Letter re: MDEQ's Comments on the July 2000 Proposed Cleanup Plan for the Ionia City Landfill Site	2
2	09/28/00	Short, T., U.S. EPA	Administrative Record	Memorandum re: PRP Comments on Kanouse Drain as a State-Protected Water Body	3
3	PENDING	Mund, W. U.S. EPA	File	Record of Decision: Ionia City Landfill	

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
IONIA CITY LANDFILL
IONIA, IONIA COUNTY, MICHIGAN

UPDATE #3
SEPTEMBER 25, 2000

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	05/05/00	McLaren/Hart, Inc.	U.S. EPA	Revised Remedial Investigation Report for the Ionia City Landfill Site: Volume 1 of 2 (Text)	132
2	05/05/00	McLaren/Hart, Inc.	U.S. EPA	Revised Remedial Investigation Report for the Ionia City Landfill Site: Volume 2 of 2 (Tables and Figures)	300
4	06/09/00	Fairbanks, C., Michigan Department of Environmental Quality	Short, T., U.S. EPA	Mixing Zone Determination Packets for the Grand River and Kanouse Drain/Wetland w/ Attached Cover Letter	47
5	06/29/00	McLaren/Hart, Inc.	U.S. EPA	Feasibility Study Update for the Ionia City Landfill Site	197
6	07/00/00	U.S. EPA	Public	Fact Sheet: Proposed Plan for the Ionia City Landfill Site	10
7	07/07/00	Short, T., U.S. EPA	Nagel, H. Hall Fowler Memorial Library	Letter re: Update to Information Repository Documents for the Ionia Landfill Site	1
8	07/14/00	Short, T., U.S. EPA	Smith, R. McLaren/Hart Environmental Engineering Corporation	Letter: U.S. EPA's Approval with Comments on the May 5, 2000 Revised Remedial Investigation Report for the Ionia City Landfill Site	7
9	07/17/00	Thelen, C., MDEQ	Brandt, P., MDEQ	Memorandum re: Mixing Zone Determination for the Ionia City Landfill Site w/Tables Concerning Recommendations for Discharge to the Grand River and Kanouse Drain	2

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
10	07/24/00	Miller, S., Ionia Resident	U.S. EPA	Public Comment Sheet re: Citizen's Comments on the Cleanup Plan for the Ionia City Landfill Site	1
11	07/28/00	Short, T., U.S. EPA	Smith, R., McLaren/Hart Environmental Engineering Corporation	Letter re: U.S. EPA's Comments on the June 29, 2000 Revised Feasibility Study for the Ionia Landfill Site	6
12	07/28/00	Short, T., U.S. EPA	Nagel, H. Hall Fowler Memorial Library	Letter re: Update to Information Repository Documents for the Ionia City Landfill Site	1
13	08/08/00	Fairbanks, C., MDEQ	Short, T., U.S. EPA	Letter re: MDEQ's Request for a Thirty Day Extension to the Public Comment Period for the Proposed Cleanup Plan for the Ionia City Landfill Site	1
14	08/11/00	U.S. EPA	Public	U.S. EPA Public Notice re: Extension of the Public Comment Period on the Proposed Plan for the Ionia City Landfill Site to August 30, 2000 (*Sentinel-Standard*)	1
15	08/25/00	U.S. EPA	Public	U.S. EPA Public Notice re: Extension of the Public Comment Period on the Proposed Plan for the Ionia City Landfill Site to September 7, 2000 (*Sentinel-Standard*)	1
16	08/28/00	Wieczorek, T., City of Ionia	Short, T., U.S. EPA	Letter re: City of Ionia's Comments on the Proposed Plan for the Ionia City Landfill Site	2
17	09/05/00	Short, T., U.S. EPA	Nagel, H., Hall Fowler Memorial Library	Letter re: Update to Information Repository Documents for the Ionia City Landfill Site	1

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
18	09/05/00	Short, T., U.S. EPA	Smith, R., McLaren/ Hart Environmental Engineering Corporation	Letter re: U.S. EPA's Approval, with Modifications, of the June 29, 2000 Revised Feasibility Study for the Ionia City Landfill Site w/ Attached MDEQ Comments	5
19	09/14/00	Thelen, C., MDEQ	Schrantz, P., MDEQ	Memorandum re: Revision to Mixing Zone Determination for the Ionia City Landfill Site w/Tables Concerning Recommendations for Discharge to the Grand River and Kanouse Drain	19

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
IONIA CITY LANDFILL
IONIA, IONIA COUNTY, MICHIGAN

UPDATE #2
JULY 24, 2000

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	03/06/95	Growth Environmental Services, Inc.	U.S. EPA	Supplemental Investigation Report for the Ionia Landfill Site	187
2	08/16/95	Growth Environmental Services, Inc.	U.S. EPA	Technical Memorandum: June 1995 Groundwater Sampling Event for the Ionia City Landfill Site	188
3	09/07/95	Michigan Department of Public Health and USDHHS/USPHS/ Agency for Toxic Substances and Disease Registry	U.S. EPA	Public Health Assessment Report for the Ionia City Landfill Site	56
4	09/09/97	McLaren/ Hart Environmental Engineering Corporation	U.S. EPA	Revised Basis of Design of of the Groundwater Treatment System for the Ionia City Landfill Site	37
5	09/09/97	McLaren/ Hart Environmental Engineering Corporation	U.S. EPA	Groundwater Treatment Design Specifications for the Ionia City Landfill Site	209
6	09/09/97	McLaren/ Hart Environmental Engineering Corporation	U.S. EPA	Groundwater Treatment Design Specifications (Appendix B: Manufacturer's Cut Sheets) for the Ionia City Landfill Site	184

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
7	05/28/98	McLaren/ Hart Environmental Engineering Corporation	U.S. EPA	Groundwater Recovery and Treatment System Operation and Maintenance Manual (Revision 1) for the Ionia City Landfill Site	223
8	12/22/98	McLaren/ Hart, Inc.	U.S. EPA	Technical Memorandum: 72-Hour Constant Rate Pumping Test Procedures (Revision 1) for the Ionia City Landfill Site	11
9	06/15/98	McLaren/ Hart Environmental Engineering Corporation	U.S. EPA	Report of the Start-Up Activities for the Groundwater Recovery and Treatment System at the Ionia City Landfill Site	96
10	05/01/99	City of Ionia	File	Waste Water Discharge Permit Issued to A.O. Smith/City of Ionia (Ionia Landfill PRP Group)	10
11	06/00/99	Fishbeck, Thompson, Carr & Huber	U.S. EPA	Baseline Groundwater Monitoring Report for the Ionia City Landfill Site	494
12	10/05/99	Fishbeck, Thompson, Carr & Huber	U.S. EPA	Quarterly Operation and Maintenance Status Report for the Ionia City Landfill Groundwater Recovery and Treatment System	91
13	12/00/99	Roy F. Weston, Inc.	U.S. EPA	Final Community Involvement Plan for the Ionia City Landfill Superfund Site	68
14	01/07/00	McLaren/ Hart, Inc.	U.S. EPA	Groundwater Trend Analysis Report for the Ionia City Landfill Site	38
15	01/07/00	McLaren/ Hart, Inc.	U.S. EPA	Groundwater Trend Analysis Report (Appendix A) for the Ionia City Landfill Site	434

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
16	01/27/00	McLaren/ Hart, Inc.	U.S. EPA	Screening Ecological Risk Assessment (Revision 2) for the Former Ionia City Landfill Site	116
17	01/27/00	McLaren/ Hart, Inc.	U.S. EPA	Screening Ecological Risk Assessment (Revision 2) for the Former Ionia City Landfill Site	200
18	01/28/00	Fishbeck, Thompson, Carr & Huber	U.S. EPA	Quarterly Operation and Maintenance Status Report for the Ionia City Landfill Groundwater Recovery and Treatment System	111
19	02/02/00	McLaren/ Hart, Inc.	U.S. EPA	Evaluation of Potential Human Health Risks (Final Revision) for the Former Ionia City Landfill Site	104
20	03/08/00	McLaren/ Hart, Inc.	U.S. EPA	Groundwater Extraction System Modification No. 1 Detail Specifications for the Ionia City Landfill Site	164
21	03/10/00	Smith, R., McLaren/ Hart, Inc.	Short, T., U.S. EPA	Letter re: Amendment to Revision #2 of the Screening Ecological Risk Assessment for the Former Ionia Landfill Site	4
22	03/23/00	Gilbertsen, R., & J. Burton; Roy F. Weston, Inc.	Short, T., U.S. EPA	Letter re: Evaluation of Monitored Natural Attenuation for the Ionia City Landfill Site	18
23	04/17/00	McLaren/ Hart, Inc.	U.S. EPA	Groundwater Extraction System Modification No. 1 As-Built Plans & Field Change Documentation for the Ionia City Landfill Site	11

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U.S. EPA ADMINISTRATIVE RECORD
REMOVAL ACTION
IONIA CITY LANDFILL
IONIA, MICHIGAN
UPDATE #1
10/31/95

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	11/09/94	Van Otteren, B., MDNR	Benfield, L., Foley & Lardner	Letter re: the Need to Backfill the Point Source Excavation at the Ionia City Landfill w/Attachments	6
2	11/28/94	Looney, M. and Palet, D., Earth Technology Corporation	Gifford, M., U.S. EPA	Letters re: Excavation Air Sampling Results for the Period November 2-28, 1994 and Background Air Sampling Results for the Period October 18-22, 1994.	44
3	12/04/94	Looney, M. and Smith, R., Earth Technology Corporation	Gifford, M., U.S. EPA	Memorandums re: Point Source Removal Action Weekly Reports for the Period October 17-December 4, 1994	81
4	01/10/95	Looney, M., Earth Technology Corporation; et al.	Gifford, M., U.S. EPA	Letter re: Disposition of Decontamination and Excavation Liquids	2
5	02/03/95	Radcliffe, M., et al.; Earth Technology Corporation	Gifford, M., U.S. EPA	Cover Letter Forwarding the Report on Point Source Removal Action Activities	1
6	03/07/95	Smith, R. and Looney, M., Earth Technology Corporation	Gifford, M., U.S. EPA	Cover Letter Forwarding the December 1994 Quarterly Groundwater Sampling Event Technical Memorandum and the Supplemental Investigation Report	1
7	03/09/95	Benfield, L., Foley & Lardner	Gifford, M., U.S. EPA	FAX Transmittal re: Scope and Extent of a Potential Groundwater Remedy	1
8	03/27/95	Gifford, M., U.S. EPA	Smith, R., Growth Environmental Services, Inc.	Letter re: U.S. EPA's Review Comments on the February 3, 1995 Report on Point Source Removal Action Activities	2
9	04/07/95	Gifford, M., U.S. EPA	Benfield, L., Foley & Lardner	Letter re: U.S. EPA's Approval of Contractor and Project Coordinator for the Ionia City Landfill	1
10	[illegible]	Gifford, M., U.S. EPA	[illegible], R., Growth Environmental Services, Inc.	Letter re: Contaminated Groundwater Issues	2
11	[illegible]	Looney, M., Growth Environmental Services, Inc.	Gifford, M., U.S. EPA	Letter re: Site Restoration Activities	1

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
12	05/15/95	Growth Environmental Services, Inc.	U.S. EPA	Report: Groundwater Removal Action Alternative Evaluation w/Cover Letter	162
13	05/19/95	Van Otteren, B., MDNR	Looney, M., Growth Environmental Services, Inc.	Letter re: Optimal Planting Methods for Native Grasses and Wildflowers	2
14	06/08/95	Bolio, M., MDNR	Van Otteren, B., MDNR	Memorandum re: MDNR's Review Comments on the Groundwater Removal Action Alternative Evaluation	3
15	06/13/95	Gifford, M., U.S. EPA	Smith, R., Growth Environmental Services, Inc.	Letter re: U.S. EPA's Review of the Groundwater Removal Action Alternative Evaluation w/Attachment	14
16	06/21/95	Van Otteren, B., MDNR	Gifford, M., U.S. EPA	Letter re: Groundwater Cleanup Performance Standards	2
17	07/11/95	Looney, M., Growth Environmental Services, Inc.	Gifford, M., U.S. EPA	Cover Letter Forwarding Pump Test Procedures Technical Memorandum	1
18	07/14/95	Kinsall, G., et al.; Roy F. Weston, Inc.	Gifford, M., U.S. EPA	Letter re: Weston's Review Comments on the July 10, 1995 Pump Test Procedures Technical Memorandum	4
19	07/25/95	Growth Environmental Services, Inc.	U.S. EPA	Report: Revised Pump Test Procedures Technical Memorandum (Revision 1) w/Cover Letter	14
20	07/31/95	Gifford, M., U.S. EPA	Smith, R., Growth Environmental Services, Inc.	Letter re: U.S. EPA's Approval w/ Modifications of the July 24, 1995 Revised Pump Test Procedures Technical Memorandum	1
21	08/09/95	Smith, R., Growth Environmental Services, Inc.	Gifford, M., U.S. EPA	Memorandums re: Monthly Progress Reports for June and July 1995	1
22	08/16/95	Growth Environmental Services, Inc.	U.S. EPA	Report: June 1995 Groundwater Sampling Event Technical Memorandum w/Cover Letter	189
23	08/22/95	Gilbertsen, R. and Krishnan, P.; Roy F. Weston, Inc.	Gifford, M., U.S. EPA	Letter re: Oversight Report for the August 1995 Aquifer Pumping Test	8
24	08/31/95	Looney, M., Growth Environmental Services, Inc.	Gifford, M., U.S. EPA	Letter re: Revised Report on Point Source Removal Action Activities	4

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
25	08/31/95	Growth Environmental Services, Inc.	U.S. EPA	Report on Point Source Removal Action Activities (Revision 1): Volume 1 of 9 [Text; Appendices A-F Incorporated by Reference]	20
26	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 2 of 9 [Appendix F]	377
27	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 3 of 9 [Appendix G]	349
28	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 4 of 9 [Appendix G]	345
29	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 5 of 9 [Appendix G]	311
30	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 6 of 9 [Appendix G]	210
31	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 7 of 9 [Appendix G]	231
32	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 8 of 9 [Appendix H]	369
33	08/31/95	Earth Technology Corporation	U.S. EPA	Report on Point Source Removal Action Activities (February 3, 1995): Volume 9 of 9 [Appendices H-I]	200
34	09/20/95	Gifford, M. and Jaster, M., U.S. EPA	Benfield, L., Foley & Lardner	Letter re: U.S. EPA's Review and Approval of the August 31, 1995 Revised Report on Point Source Removal Action Activities	2
35	09/29/95	U.S. EPA		Action Memorandum: Determination of Threat to Public Health, Welfare or the Environment	19
36	09/29/95	U.S. EPA	Respondents	Administrative Order by Consent	27

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U.S. EPA ADMINISTRATIVE RECORD
REMOVAL ACTION
IONIA CITY LANDFILL
IONIA, MICHIGAN
ORIGINAL
10/24/94

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	08/29/89	U.S. EPA		Remedial Administrative Record [Original: 1 Microfiche Volume] (Documents Comprising the AR are Incorporated by Reference and May be Viewed at U.S. EPA Region 5, 77 W. Jackson Blvd., Chicago, IL 60604-3590)	2637
2	09/29/89	Adamkus, V., U.S. EPA	U.S. EPA	Operable Unit Record of Decision, Selected Source Control Remedial Alternative	59
3	11/15/89	U.S. EPA		Remedial Administrative Record [Update #1: 2 Volumes] (Documents Comprising the AR are Incorporated by Reference and May be Viewed at U.S. EPA Region 5, 77 W. Jackson Blvd., Chicago, IL 60604-3590)	372
4	06/17/91	United States of America	Settling Defendants	Consent Decree w/Appendices	187
5	04/18/94	Gifford, M. and Prout, S., U.S. EPA	Smith, R., Earth Tech.; and Benfield, L., Foley & Lardner	Letter re: Analytical Data from Groundwater Samples Collected in November 1993 Requiring a Reevaluation of Current Site Status	3
6	04/28/94	Smith R., Earth Technology Corporation	Gifford, M. and Prout, S., U.S. EPA	Letter re: (1) Groundwater Contamination and Point Source Removal Action; and (2) Groundwater Monitoring Network w/Attachments	5
7	05/31/94	Smith, R. and Looney, W., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter Forwarding the Work Plan for Removal Action Activities for U.S. EPA Review	1
8	06/15/94	Gilbertsen, R. and Krishnan, P., Roy F. Weston, Inc.	Gifford, M., U.S. EPA	Letter re: Weston's Review Comments on the Removal Action Work Plan	4
9	06/20/94	Gifford, M., U.S. EPA	Smith, R., Earth Technology Corporation	Letter re: U.S. EPA's Review Comments on the Removal Action Work Plan and Envirogen Proposed Work Plan	4
10	06/21/94	Feld, R., Environmental Quality Company	Smith, R., Earth Technology Corporation	Letter Forwarding Attached Guidance re: Characterization of Wastes that Carry the D018-43 Waste Codes	4
11	06/28/94	Van Otteren, B., MDNR	Gifford, M., U.S. EPA	Letter re: MDNR's Review of the Removal Action Work Plan w/Attachments	29

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
12	06/28/94	Smith, R., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter re: Off-Site Disposal Requirements	4
13	07/29/94	Smith, R. and Looney, W., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter re: Delay of the Point Source Sampling Activity	3
14	08/02/94	Earth Technology Corporation	Gifford, M., U.S. EPA	Letter re: Revised Point Source Sampling Procedures	20
15	09/15/94	Smith, R. and Looney, W., Earth Technology Corporation	Bivik, R., U.S. EPA	Letter Forwarding Attached Standard Operating Procedures for Laboratory Analysis Methods, Point Source Removal Action, for U.S. EPA Review	197
16	09/16/94	Smith, R., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter in Response to U.S. EPA's September 9, 1994 Letter re: Groundwater Evaluation and Selection of a Groundwater Treatment Technology	8
17	09/22/94	Earth Technology Corporation	U.S. EPA	Removal Action Work Plan: Volume 1 of 2 (Revision 1)	189
18	09/23/94	Smith, R. and Looney, W., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter Forwarding the Revised Removal Action Work Plan for U.S. EPA Review	1
19	09/23/94	Earth Technology Corporation	Gifford, M., U.S. EPA	Letter re: Supplemental Point Source Sampling Activities w/Attachments	18
20	09/23/94	Earth Technology Corporation	U.S. EPA	Results of Point Source Waste Characterization Sampling (August 1994 Sampling Event)	112
21	09/26/94	Smith, R. and Looney, W., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter Forwarding Attached Information re: the Environmental Quality Company's Belleville Facility's Hazardous Waste Acceptance Procedures	74
22	09/28/94	Van Otteren, B., MDNR	Gifford, M., U.S. EPA	Letter re: MDNR's Comments on the Removal Action Work Plan	2
23	10/04/94	Smith, R. and Looney, W., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter re: Schedule for Field Activities	4

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
24	10/07/94	Earth Technology Corporation	U.S. EPA	Attachment B: Standard Operating Procedures for Laboratory Analysis Methods to the Quality Assurance Project Plan for Removal Action	224
25	10/07/94	Gifford, M., U.S. EPA	Smith, R., Earth Technology Corporation	Letter re: U.S. EPA's Approval of the Supplemental Point Source Sampling Activities w/Comments	1
26	10/07/94	Earth Technology Corporation	U.S. EPA	Removal Action Work Plan: Volume 2 of 2 (Revision 2)	261
27	10/11/94	Gifford, M, U.S. EPA	Smith, R., Earth Technology Corporation	Letter re: U.S. EPA's Approval of the Revised Removal Action Work Plan w/Modifications	3
28	10/17/94	Smith, R., Earth Technology Corporation	Gifford, M., U.S. EPA	FAX Transmittal in Response to U.S. EPA's October 11, 1994 Letter re: Amendments to the Removal Action Work Plan	3
29	10/17/94	Smith, R., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter re: Weekly Reporting Requirements for the Point Source Removal Action Activities	1
30	10/18/94	Smith, R., Earth Technology Corporation	Gifford, M., U.S. EPA	Letter re: Notification that Selected Disposal Facilities are in Compliance	1
31	10/24/94	Gifford, M., U.S. EPA	Muno, W., U.S. EPA	Action Memorandum: Determination of Threat to Public Health, Welfare or the Environment	18
32	10/24/94	U.S. EPA	Settling Potentially Responsible Parties	Administrative Order by Consent	26

Remedial
ENDS 1/ 9/87 CSD

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IONIA CITY LANDFILL
IONIA, MICHIGAN

ICH1/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
2 A1	6	81/04/10	MDNR concern that there may be materials buried at the site that may have contaminated the environment and the drums must be uncovered to determine their potential hazard.	Richard Lundgren-MDNR	A.Houser-City Supt. Ionia	Correspondence	1
2 A14	7	84/06/19	Request for Information and notification of actions that the USEPA is planning to take.	Basil Constantelos-USEPA	See service list	Correspondence	2
2 B7	2	84/09/07	Confirmation of a request that the USEPA carry out a CERCLA RI/FS.	Ronald Skoog-MDNR	Valdas Adamkus-USEPA	Correspondence	3
2 B9	4	85/04/12	Request for information as to the recipient's willingness to conduct or participate in the RI/FS in accordance with the EPA's work plan.	Basil Constantelos-USEPA	See service list	Correspondence	4
2 B13	5	85/08/02	Request for Information.	Basil Constantelos-USEPA		Correspondence	5
2	2	85/08/09	Notice that company can not agree to participate in or conduct the RI/FS.	Michael Grice-Chrysler	John Oaks-USEPA	Correspondence	6
2 C8	2	85/08/13	Request that the USEPA explain the basis for the allegation that Steelcase, Inc. is a PRP and as such is unable to make a commitment at this time to conduct or participate in the RI/FS.	Eugene Smary-Warner,Norcross & Judd	John Oaks-USEPA	Correspondence	7
2 C8	6	85/08/29	Review of Work Plan Prepared By Radian Corp. and review comments relative to the Endangerment Assessment.		USEPA	Correspondence	8

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ME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	1	85/08/29	Denial of ever having placed hazardous materials at the site.	Brian Jordan-Michigan Bell	John Oaks-USEPA	Correspondence	9
	6	85/09/05	Objection to the inclusion of Greenville Products Co. as a PRP and a response to a Request for Information.	Stephenson-Squires,Sander sDempsey	John Oaks-USEPA	Correspondence	10
	7	85/09/11	Ionia Landfill Work Plan for the RI/FS and the authoring company's Resolution of Review Comments.	J.B.McCutchan-Radian Corp.	Peter Miller-USEPA	Correspondence	11
	2	85/09/11	Response to Request for Information.	Michael Grice-Chrysler Corp.	Robert Leininger-USEPA	Correspondence	12
	6	85/09/16	Response to Request for Information.	Leonard Charles-General Motors Corp	Robert Leininger-USEPA	Correspondence	13
	2	86/02/28	Response to Request for Information.	Jack Shugate-Consumers Power Co.	John Oaks-USEPA	Correspondence	14
	1	86/04/04	The USEPA has determined that the Administrative Order by Consent should be made effective as issued as of the date of this letter.	Valdas Adamkus-USEPA	Michael-Kearney-A.O. Smith	Correspondence	15
	3	86/06/09	Author has reviewed the RI/FS Workplan and finds it acceptable except for the noted points.	Gary Hoffmaster-MDNR	Peter Miller-USEPA	Correspondence	16
	18	86/07/15	First round of comments on the RI/FS QAPP and Technical Plan.	Peter Miller-USEPA	Kim Anderson-A.O.Smith	Correspondence	17
	5	86/07/28	Response to EPA's 7/15/86 comment letter for the Ionia City Landfill RI/FS QAPP and Technical Work Plan.	Rick Smith-Rollins Env. Services	Peter Miller-USEPA	Correspondence	18
	4	86/09/11	Revision no. 1 to the	Rick Smith-Rollins Env.	Peter Miller-USEPA	Correspondence	19

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ICRE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
			Work Plan for the RI/FS.	Services			
3 A4	2	87/01/13	Revisions to the Ionia City Landfill Remedial Investigation/Feasibility Study Work Plan.	Rick Smith-Rollins Env. Services	Peter Miller-USEPA	Correspondence	20
3 A6	7	87/02/09	Summaries of analyses of samples of well water taken from six residential wells and one municipal water supply well near the landfill.	Peter Miller-USEPA	Gary Hoffmaster-MDNR	Correspondence	21
3 A13	1	87/02/12	Revised work schedule for the Remedial Investigation.	Rick Smith-Rollins Env. Services	Peter Miller-USEPA	Correspondence	22
3 A	8	87/02/26	Revisions to the Ionia City Landfill RI/FS Quality Assurance Project Plan.	Smith & Archer-Rollins Env.Services	Peter Miller-USEPA	Correspondence	23
3 B8	4	87/04/17	Magnetometer Study and proposed trenching locations.	Smith & Archer-Rollins Env.Services	Peter Miller-USEPA	Correspondence	24
3 B14	2	87/05/06	Review of on site safety procedures and employee training.	James Novak-MDPH	Rick Smith-RollinsEnv.Ser	Correspondence	25
3 C2	1	87/06/01	Recommendation that six additional test pits be dug in area A to estimate the size of buried drum concentrations.	Gary Hoffmaster-MDNR	Peter Miller-USEPA	Correspondence	26
3 C3	1	87/06/30	Transmittal of Tech.Memo. On-site Subsurface Soil Sampling and Tech. Memo. Surface Water & Sediment Sampling.	Smith & Targas-Rollins Env.Services	Peter Miller-USEPA	Correspondence	27
3	3	87/09/19	Transmittal letters sending the Task Six Tech. Memo., the Task	Rick Smith-Rollins Env. Services	Peter Miller-USEPA	Correspondence	28

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			810 Tech. Memo., and the Task 320 Tech. Memo.				
3 C7	2	87/08/26	Rollins has evaluated the analytical data from the first monitor well sampling round to recommend the number of samples and the analyses required for the second round of ssampling.	Rick Smith-Rollins Env. Services	Peter Miller-USEPA	Correspondence	29
	2	87/09/02	Issues concerning the following items need to be resolved prior to completing the RI/FS field work: Groundwater sampling, round II; red bed well drilling; biota sampling; and additional test pitting.	Peter Miller-USEPA	Gary Hoffmaster-MDNR	Correspondence	30
3 C11	1	87/09/10	The USEPA has determined that analysis for semi-volatiles in ground water is needed for the stated reasons.	Peter Miller-USEPA	Kim Anderson-A.O.Smith	Correspondence	31
3	1	87/09/18	Request pursuant to the Consent Order that additional RI/FS work be performed to further characterize the contamination..	Peter Miller-USEPA	Kim Anderson-A.O.SMith	Correspondence	32
3 C13	2	87/09/22	Comments on several fieldwork tasks for the RI/FS.	Gary Hoffmaster-MDNR	Peter Miller-USEPA	Correspondence	33
3 D1	1	87/10/26	Assumption that the only pockets of buried drums are in trenches 7 and 8 may be incorrect. Author therefore suggests that Rollins excavate several test pits at locations in Area A outside of the general locations of trenches 7 and 8 as drums	Gary Hoffmaster-MDNR	Peter Miller-USEPA	Correspondence	34

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			may be buried under the temporary cap placed over a portion of the site in 1984.				
3 D2	1	87/11/06	Request that two additional test pits be performed to address the MDNR's concern about the possibility of other masses of buried drums within area A.	Peter Miller-USEPA	Kim Anderson-A.O.Smith	Correspondence	35
3 D3	14	87/11/11	RES-FS will mobilize at the Landfill on 11/16/87. Trenching will commence between 8:00 and 9:00 a.m. on 11/17/87. Letter also sends the "Donohue report" regarding the re-evaluation of the magnetometer survey.	Rick Smith-Rollins Env.Services	Peter Miller-USEPA	Correspondence	36
3 E3	1	88/01/06	Transmittal letter sending one complete Technical Memorandum for the Hydrogeologic Investigation and one copy of the Memo excluding Attachment G.	Smith & Tangas-Rollins Env.Services	Peter Miller-USEPA	Correspondence	37
3 E4	1	88/01/15	Recommendation that the biota study be deleted from the RI/FS and requests that the MDNR concur with this suggestion.	Peter Miller-USEPA	Gary Hoffmaster-MDNR	Correspondence	38
3 E5	2	88/01/15	"Amendment to the Technical Memorandum for the Hydro-geologic Investigation of the Ionia City Landfill." This corrects the designation to Task 650.	Rick Smith-Rollins Env. Services	Peter Miller-USEPA	Correspondence	39

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CHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
3 E7	2	86/01/20	The MDNR agrees with the USEPA that the biota study is an unnecessary task under the current RI/FS.	Gary Hoffmaster-MDNR	Peter Miller-USEPA	Correspondence	40
3 E9	4	88/02/09	Comments on the Technical Memorandum for the Hydrogeologic Investigation of the RI/FS.	Gary Hoffmaster-MDNR	Mike Gifford-USEPA	Correspondence	41
3 E13	1	86/02/12	The USEPA and the MDNR have determined that there is no use in performing Task 7 of the RI/FS Work Plan (The biota study) and requests that the study be deleted from the RI/FS pursuant to the Consent Order.	Peter Miller-USEPA	Kim Anderson-A.O.Smith	Correspondence	42
3 E14	1	86/03/04	The MDNR belives that it would be appropiate to treat the site's contamination source as an operable unit seperate from the groundwater contaminant plume.	Gary Hoffmaster-MDNR	Mike Gifford-USEPA	Correspondence	43
3 F1	4	86/03/18	The author and the MDNR agree with the reccmmendations regarding additional work proposed on page 51 of the Hydrogeologic Investigation Tech. Memo. As a related topic, the MDNR and the USEPA concur with the parameters proposed for the next round of sampling. It is also agreed that no further delineation of the drum disposal area is required at this time.	Mike Gifford-USEPA	Kim Anderson-A.O.Smith	Correspondence	44

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			One concern has surfaced as a result of the additional RI field activities proposed for this spring is the impact the field work will have on the timely completion of the RI/FS. An alternative is to identify the drum disposal or source area as an operable unit. Furthermore, it is anticipated that delineation of the contaminant plume will minimally affect the alternatives screened and remedy selected for the source area.				
3F	2	88/04/11	Information on who to contact for information concerning in-situ vitrification and its applicability for hazardous waste treatment and soil stabilization.	Mike Gifford-USEPA	Rick Smith-Rollins Env.	Correspondence	45
3	12	88/04/11	"Response to EPA's 3/18/88 Comment Letter and a Revised Schedule for the Remedial Investigation/ Feasibility Study of the Ionia City Landfill."	Smith & Targas-Rollins Env.Services	Mike Gifford-USEPA	Correspondence	46
3G5	1	88/04/29	Notice that work crews will be installing several additional monitoring wells at the landfill during the week of May 2, 1988. Also, author states that there is evidence of illegal dumping at the site and that access should be restricted.	Gary Hoffmaster-MDNR	Housler-Ionia City Super.	Correspondence	47

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TIME/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
G6	1	88/05/11	Author believes it would be prudent that the additional round of well sampling include the deep wells.	Gary Hoffmaster-MDNR	Mike Gifford-USEPA	Correspondence	48
G7	2	88/12/05	Comments on the Endangerment Assessment.	Gary Hoffmaster-MDNR	Mike Gifford-USEPA	Correspondence	49
G9	9	88/12/14	Comments on the Endangerment Assessment.	P.Krishnan-Roy F. Weston, Inc.	Mike Gifford-USEPA	Correspondence	50
A7	8	88/12/16	Revised project schedule for the RI/FS and the USEPA's comments on the Draft Endangerment Assessment.	Mike Gifford-USEPA	Kim Anderson-A.O.Smith	Correspondence	51
B*	3	89/01/20	Comments on the Hydrogeological Investigation Technical Memorandum.	Need & Krishnan-Roy F. Weston, Inc.	Mike Gifford-USEPA	Correspondence	52
4 B4	2	89/02/22	Review of the Alternatives Array Document.	Gary Hoffmaster-MDNR	Mike Gifford-USEPA	Correspondence	53
4 B6	4	89/03/16	Comments on the Alternatives Array Document.	P.Krishnan-Roy F. Weston, Inc.	Mike Gifford-USEPA	Correspondence	54
4 B10	4	89/05/11	Comments on the Draft RI Report.	P.Krishnan-Roy F.Weston, Inc.	Mike Gifford-USEPA	Correspondence	55
4 B14	2	89/05/16	Confirmation of meeting to be held on 5/25/89 to discuss the RI/FS. Also, a request for a written response that summarizes and documents the problems encountered by Rollins Environmental and ETC Toxicon Labs in the preparation of the final analytical data packages. Concerns are also expressed that the	Mike Gifford-USEPA	Kim Anderson-A.O.Smith	Correspondence	56

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			revised Endangerment Assessment has not been submitted to the USEPA and with the rapid approach of the ROD deadline.				
4 C2	5	89/05/18	Review of the Draft RI. Also included are the comments of Ms. Kathy Shirey of the MDNR.	Gary Hoffmaster-MDNR	Mike Gifford-USEPA	Correspondence	57
	7	89/05/24	Comments on the Remedial Investigation.	Mike Gifford-USEPA	R.Smith-EarthTechnol ogies	Correspondence	58
4 C14	1	89/06/22	Cover letter transmitting Second Submittal of the Draft Remedial Investigation Report.	Smith & Looney-Earth Tech. Corp.	Mike Gifford-USEPA	Correspondence	59
4 C	14	89/07/14	Group of review comments on the Draft Feasibility Study.	Mike Gifford-USEPA	Rick Smith-EarthTech.Corp	Correspondence	60
4 E1	4	89/07/18	Review comments on the Draft FeEasiblity Study with attachment.	Gary Hoffmaster-MDNR	Mike Gifford-USEPA	Correspondence	61
4	16	89/07/19	Group of review comments on the Draft Feasibility Study.	Mike Gifford-USEPA	Rick Smith-EarthTech.Corp	Correspondence	62
4 F9	7	89/07/25	Review comments on the Draft Feasibility Study by Susan Prout of the USEPA-ORC.	Mike Gifford	Rick Smith-EarthTech.Corp	Correspondence	63
4 G2	3	87/02/25	"Remedial Investigation/ Feasibility Study (RI/FS) Begins."	MDNR		Fact Sheet	64
4 G5	2	87/04/08	"Remedial Investigation Continues" and "Test Pit Excavations in May	MDNR		Fact Sheet	65
4 C	2	87/04/23	"Test Pit Excavations Begin" and "Site Air Emissions Monitored".	MDNR		Fact Sheet	66

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RE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
G9	2	87/05/28	"Test Pit Excavation Completed."	MDNR		Fact Sheet	67
G11	3	87/09/15	"Ionia Fieldwork Continues."	MDNR		Fact Sheet	68
G14	2	87/11/13	"Ionia Site Investigation Continues."	MDNR		Fact Sheet	69
A2	2	86/05/03	"Ionia Landfill Investigation Continues."	MDNR		Fact Sheet	70
A4	8	84/06/11	Immediate Removal Request for the Ionia Landfill Site, Ionia, Landfill.	Briand Wu-USEPA	Valdas Adamkus-USEPA	Memorandum	71
A12	19	84/11/16	ACTION MEMORANDUM: Authorization to Proceed with a Remedial Investigation and Feasibilty Study at the Ionia City Landfill, Ionia, Michigan. Attached is the RI/FS Statement of Work.	Basil Constantelos-USEPA	Valdas Adamkus-USEPA	Memorandum	72
C	2	84/11/27	Memo on the first phase of the Responsible Party Cleanup - synopsis.	Jack Barnette-USEPA	Files	Memorandum	73
C5	2	85/02/12	Trip Report for Ionia City Landfill. Trip was made to become more familar with the site for review if the RI/FS Workplan and possible removal action.	Mike McLeod-USEPA	Files	Memorandum	74
C7	2	85/03/21	Update on the Immediate Removal at the Cleveland St. Landfill, Ionia, Michigan.	Jack Barnette-USEPA	Robert Bowden-USEPA	Memorandum	75
C9	15	85/05/29	Review of Ionia Landfill Work Plan prepared by CH2M Hill.	Joseph Glassman-Clement Assoc.	F.Brisbman-Roy F.Weston	Memorandum	76
D10	8	87/02/03	Approval of Quality	James Adams-USEPA	Norm	Memorandum	77

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ICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
			Assurance Project Plan for the Remedial Investigation/Feasibility Study with attached page changes.		Niedergang-USEPA		
5 E4	1	87/10/16	Review of approximately 50% of the organic data and 100% of the dioxin data.	Patrick Churilla-USEPA	Peter Miller-USEPA	Memorandum	78
5 F	2	87/11/02	Review of inorganic data.	Raymond Piccone-USEPA	Peter Miller-USEPA	Memorandum	79
5 E7	1	88/09/09	Request for comments on the Draft Endangerment Assessment.	Mike Gifford-USEPA	Addressees	Memorandum	80
5 E8	2	88/10/19	Comments on the Draft Endangerment Assessment.	Steve Rothblatt-USEPA	Maty Gade-USEPA	Memorandum	81
5 E	3	88/10/20	Comments on the Draft Endangerment Assessment.	Susan Prout-USEPA	Mike Gifford-USEPA	Memorandum	82
5 E13	4	89/02/13	Request for review of the Draft Alternatives Array Document.	Mike Gifford-USEPA	Addressees	Memorandum	83
5 F6	2	89/03/15	Water Division review of the Alternatives Array.	Charles Suftin-USEPA	Basil Constantelos-USEPA	Memorandum	84
5 F7	1	89/03/15	Comments on the Draft Alternatives Array Document.	Diane Spencer-USEPA RCRA Permitting	Mike Gifford-USEPA	Memorandum	85
5 F8	5	89/03/26	Comments on the Draft Alternatives Array Document.	Dr. Luanne Vanderpool-USEPA	Mike Gifford-USEPA	Memorandum	86
5 F13	2	89/04/28	Request for comments on the Draft RI and on the Alternatives Array Documents.	Mike Gifford-USEPA	Addressees	Memorandum	87
5 G1	2	89/05/17	Comments on the Draft RI.	Steve Rothblatt-USEPA	Mike Gifford-USEPA	Memorandum	88
5 G	3	89/05/30	Water Division Review of the Draft Remedial Investigation.	Charles Suftin-USEPA	Basil Constantelos-USEPA	Memorandum	89

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5 G6	3	89/05/30	Review of the Draft Remedial Investigation Report.	Dr. Luanne Vanderpool-USEPA	Mike Gifford-USEPA	Memorandum	90
5 G9	2	89/06/10	Review comments on the Draft Feasibilty Study.	Pamela Blakley-USEPA	Mike Gifford-USEPA	Memorandum	91
5 G11	1	89/06/19	Request for review and comments on the Draft FS.	Mike Gifford-USEPA	Addressees	Memorandum	92
5 G[illegible]	15	84/06/19	Administrative Order.	Valdas Adamkus-USEPA	A.Housler-City of Ionia	Pleadings/Orders	93
5 A13	9	84/07/12	Respondant Proposal to the Administrative Order issued 6/19/84.	City of Ionia	USEPA	Pleadings/Orders	94
5 B8	6	84/08/01	Amended Administrative Order.	Alan Levin for Valdas Adamkus-USEPA	A.Housler-City of Ionia	Pleadings/Orders	95
6 B14	68	86/01/29	Administrative Order By Consent and Statement of Work.	USEPA	A.O.Smith & Mitchell Corp	Pleadings/Orders	96
6 G13	13	00/00/00	Documentation Records for Hazard Ranking System.	Ecology & Environment		Reports/Studies	97
7	11	81/11/00	Pollution Incident No. 248-81, Thursday, Feb.19, 1981.	Richard Lundgren-MDNR		Reports/Studies	98
7 B13	13	82/05/05	Site Safety Plan: to sample back water area down-gradient of contaminated aquifer and conduct air monitoring.	April Richards-Ecology & Environ.	USEPA	Reports/Studies	99
7 C13	14	82/07/12	Site Inspection Report.	D.Sewall-Ecology & Environment	USEPA	Reports/Studies	100
7 D13	7	82/07/25	Hazard Ranking System (HRS) Scoring Package.	April Richards-Ecology & Environ.	USEPA	Reports/Studies	101
7	8	83/02/17	Preliminary Assessment.	Tom Koch-Ecology & Environment	File/USEPA	Reports/Studies	102
7 E11	12	84/05/14	Geophysical Investigation	Delta Geophysical	IT Corp.	Reports/Studies	103

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			Ionia City Landfill for IT Corporation.	Services			
7 G3	17	85/06/13	Initial Site Visit Memorandum.	P.Krisnan-Roy F. Weston, Inc.	J.Hawthorne-Camp Dresser	Reports/Studies	104
8 A6	46	85/09/20	Remedial Investigation and Feasibility Study - Work Plan.	Radian Corp.	A.O.Smith	Reports/Studies	105
8 D11	36	86/03/17	Draft Appendicies A through H required for the RI/FS.	Rick Smith-Rollins Env. Services	Kim Anderson-A.O.Smith	Reports/Studies	106
8 G6	331	86/09/10	Work Plan: Technical Plan/Health and Safety Plan for the RI/FS.	Rollins Environmental Services	A.O.Smith & Mitchell Corp	Reports/Studies	107
12 C	15	86/09/26	Summary of the oversite actvities conducted by the TAT at this site during the Responsible Party Cleanup.	Geers & Springer-Roy F. Weston,Inc.	Briand Wu-USEPA	Reports/Studies	108
12 E3	17	86/10/10	Quality Assurance Project Plan - Residential Well Water Sampling along with the approval memorandum authored by James Adams of the USEPA.	Soobok Hong & Peter Miller-USEPA		Reports/Studies	109
12 F5	3	86/11/25	Ionia Progress Report #1 for activities from February 12, 1986 to November 25, 1986.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	110
12 F8	2	86/12/30	Ionia Progress Report #2 for December, 1986.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	111
12 F10	416	87/01/09	Work Plan: Quality Assurance Project Plan for the RI/FS.	Rollins Environmental Services	A.O.Smith & Mitchell Corp	Reports/Studies	112
17	48	87/01/19	Appendix A Health And Safety Plan.	Rollins Environmental Services FSI	A.O.Smith	Reports/Studies	113
17 E12	2	87/01/29	Ionia Progress Report #3	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	114

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			for January, 1987.				
7 E14	2	87/02/23	Ionia Progress Report #4 for February, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	115
7 F2	63	87/03/31	Magnetometer Survey.	Hydro-Search, Inc.	Rollins Environmental Ser	Reports/Studies	116
8 D3	3	87/04/03	Ionia Progress Report #5 for March, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	117
8 [illegible]	36	87/04/29	Work Plan Volume I - Technical Scope of Work.	Camp Dresser & McKee	USEPA	Reports/Studies	118
8 G8	4	87/05/04	Ionia Progress Report #6 for April, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	119
18 G10	2	87/06/01	Ionia Progress Report #7 for May, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	120
18 [illegible]	92	87/06/30	Technical Memorandum On-Site Subsurface Soil Sampling.	Rollins Environmental Services		Reports/Studies	121
19 G13	129	87/06/30	Technical Memorandum Surface Water and Sediment Sampling.	Rollins Environmental Services		Reports/Studies	122
2 [illegible]	2	87/07/02	Ionia Progress Report #8 for June, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	123
21 C12	2	87/08/04	Ionia Progress Report #9 for July, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	124
21 C14	26	87/08/19	Techinal Memorandum Air Monitoring.	Rollins Environmental Services		Reports/Studies	125
21 F6	60	87/08/19	Technical Memorandum Analysis of Landfill Cap.	Rollins Environmental Services		Reports/Studies	126
22 B9	123	87/08/19	Technical Memorandum Drum Location and Sampling.	Rollins Environmental Services		Reports/Studies	127
23 A[illegible]	8[illegible]	87/08/26	Monitor Well Sampling (First Round).	Rollins Environmental Services	Pete Miller-USEPA	Reports/Studies	128
24 D8	1	87/09/04	Ionia Progress Report #10 for August, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	129

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24 D9	2	87/09/29	Ionia Progress Report #11 for September, 1987	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	130
24 D11	3	87/10/19	"Remedial Investigation of the Ionia City Landfill; additional activities to delineate the boundries of drum waste within area A."	Rick Smith-Rollins Env. Services	Peter Miller-USEPA	Reports/Studies	131
24 D14	2	87/11/02	Ionia Progress Report #12 for October, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	132
24 E2	2	87/11/30	Ionia Progress Report #13 for November, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	133
24 E4	60	88/01/00	Technical Memorandum Hydrogeologic Investigation (Task 600).	Rollins Environmental Services		Reports/Studies	134
25	346	86/01/00	Attachment A: Ionia City Landfill - Task 600 Boring Logs/Well Construction Diagrams.	Rollins Environmental Services		Reports/Studies	135
29 C11	2	85/01/04	Ionia Progress Report #14 for December, 1987.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	136
29 C13	2	88/02/01	Ionia Progress Report #15 for January, 1988.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	137
29 D1	2	88/03/02	Ionia Progress Report #16 for February, 1988.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	138
29 D3	2	88/03/30	Ionia Progress Report #17 for March, 1988.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	139
29 D5	2	88/05/02	Ionia Progress Report #18 for April, 1988.	Kim ANderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	140
29 D7	2	88/05/31	Ionia Progress Report #19 for May, 1988.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	141
29 D9	2	88/07/05	Ionia Progress Report #20 for June, 1988.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	142
29 L	2	88/07/29	Ionia Progress Report #21 for July, 1988.	Kim Anderson-A.O.Smith	Peter Miller-USEPA	Reports/Studies	143

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29 E1	2	88/09/30	Ionia Progress Report #23 for Spetember, 1988.	Kim Anderson-A.O.Smith	Mike Gifford-USEPA	Reports/Studies	145
29 E3	2	88/11/01	Ionia Progress Report #24 for October, 1989.	Kim Anderson-A.O.Smith	Mike Gifford-USEPA	Reports/Studies	146
29 E5	25	88/11/03	Technical Oversight Work Plan Ionia City, Michigan. Volume I - Technical Scope of Work.	Roy F. Weston, Inc.	USEPA	Reports/Studies	147
29 G2	2	88/12/02	Ionia Progress Report #25 for November, 1988.	Kim Anderson-A.O.Smith	Mike Gifford-USEPA	Reports/Studies	148
29 G4	2	89/01/05	Ionia Progress Report #26 for December, 1988.	Kim Anderson-A.O.Smith	Mike Gifford-USEPA	Reports/Studies	149
29	23	89/01/30	Alternatives Array Document.	Smith & Looney-Rollins Env.Services	Mike Gifford-USEPA	Reports/Studies	150
30 B5	2	89/01/31	Ionia Progress Report #27 for January, 1989.	Kim ANderson-A.O.Smith	Mike Gifford-USEPA	Reports/Studies	151
30 B7	2	89/02/28	Ionia Progress Report #28 for February, 1989.	Kim Anderson-A.O.Smith	Mike Gifford-USEPA	Reports/Studies	152
30 B9	5	89/03/15	Health Assessment.	ATSDR	USEPA	Reports/Studies	153
30 B14	2	89/04/03	Ionia Progress Report #29 for March, 1989.	Kim Anderson-A.O.Smith	Mike Gifford-USEPA	Reports/Studies	154
30 C2	2	89/06/05	Ionia Progress Report #31. for May, 1989.	Kim Anderson-A.O. Smith	Mike Gifford-USEPA	Reports/Studies	155

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	2	85/02/07	Letter regarding solid waste disposal activity south of C & O Railroad and east of Cleveland street	Robert W. Shaffer Ionia County Health Department	A.Housler - City Manager	Correspondence	1
	1	86/02/05	Letter acknowledging receipt of the Administrative Order	William W. Miner USEPA	[redacted]	Correspondence	2
	3	86/11/21	Comments on the September 10, 1986 version of the Ionia RI/FS QAPP (Remedial Investigation/ Feasibility Study Quality Assurance Program Plan)	Peter Miller USEPA	Dr.K.Anderson	Correspondence	3
	2	87/03/27	Letter regarding the RI/FS work and SARA (Superfund Amendments and Reauthorization Act) requirements	Basil G. Constantelos USEPA	Dr. Kim Anderson	Correspondence	4
	2	89/07/27	Letter informing of MDNR's concerns regarding EPA's preference of In-Situ vitrification (ISV) for remediation	Gary Hoffmaster MDNR	M. Gifford - USEPA	Correspondence	5
	18	89/08/47	Response to MDNR's 7/18 & 7/19 comment letters	Rick Smith/ Bill Looney The Earth Technology Corporation	M. Gifford - USEPA	Correspondence	6
	2	89/08/14	Letter discussing several points on the Ionia Landfill Feasibility Study and Proposed Plan and attached comments on the Ionia groundwater	Gary Hoffmaster/ David A. Hamilton MDNR	M. Gifford - USEPA	Correspondence	7

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			model from MDNR's Land and Water Management Division				
	1	89/08/25	Letter accompanying Administrative Record Index and Proposed Plan to repositories in Ionia	Michael Gifford USEPA	T.Wieczorek R.Bergeon	Correspondence	8
	7	89/08/29	Notice letter to notify of potential liability and provide responsible parties an opportunity to enter into negotiations	Norman Niedergang USEPA	Various PRPs	Correspondence	9
	8	89/09/20	Correspondence in response to letters requesting review and comments on the Final Proposed Plan and the draft Record of Decision; maps of site are enclosed	L.Welgus Department of the Army	M.Gifford - USEPA	Correspondence	10
	1	89/09/27	Letter of Concurrence regarding selected remedy outlined in the Record of Decision (ROD)	Delbert Rector MDNR	V.Adamkus - USEPA	Correspondence	11
	2	86/02/19	News release announcing administrative order to Mitchell Corp. and A.O. Smith Corp., which requires the companies to investigate potential migration of hazardous substances	USEPA		Fact Sheet	12
	1	89/08/24	Statement informing of Public meeting held on August 31, 1989 to discuss the Ionia City	MDNR		Fact Sheet	13

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			Landfill Remedial Investigation/Feasibility Study and Proposed Plan; and to post notice that public comment will be accepted until September 14, 1989				
	2	89/08/28	Notice declaring that USEPA and MDNR are accepting public comments on ways to clean up the Ionia Landfill Site	USEPA/MDNR		Fact Sheet	14
	28	89/08/31	Transcript from public meeting held by USEPA & MDNR to present the Proposed Plan and USEPA's perferred remedy for the site; and to accept comments from the public	USEPA		Meeting Notes	15
	3	83/10/20	Trip Report of visit to Ionia City Landfill on October 11, 1983	Francine Pollack USEPA	G.Vanderlaan - USEPA	Memorandum	16
	2	83/11/10	Memo answering questions regarding; status of Remedial Action, risks presented by site conditions, and recommendation on immediate removal action	Francine Pollack USEPA	R.Bowden	Memorandum	17
	1	84/01/19	Memo concerning Remedial Action Master Plan (RAMP)	Georgi A. Jones DHHS	L.Fabinski - USEPA	Memorandum	18
	7	84/05/11	Trip Report	Jim Knox	G.Vanderlaan - USEPA	Memorandum	19

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			purpose of trip was for On-Scene Coordinator to orient himself with the site and to assist in immediate removal	USEPA			
	8	84/06/11	Action Memo requesting funding for immediate removal work	Briand Wu USEPA	V.Adamkus - USEPA	Memorandum	20
	4 2	84/08/20	Trip and Public Meeting Report to Ionia City Landfill on August 8, 1984	Jim Knoy USEPA	G.Vanderlaan - USEPA	Memorandum	21
	2	84/11/20	Trip Report to Ionia City Landfill, MI on November 14, 1984	Jim Knoy USEPA	G.Vanderlaan - USEPA	Memorandum	22
	2	84/12/20	Memo concerning drum discovery on City of Ionia property and adjacent land	Gary Hoffmaster MDNR	P.Ollila - MDNR	Memorandum	23
	1	85/01/03	Trip Report to Ionia City Landfill	Jim Knoy USEPA	G.Vanderlaan - USEPA	Memorandum	24
	2	85/04/24	Comments on drum sampling at Summit Steel Property, Ionia	Gary Hoffmaster MDNR	P.Ollila - MDNR	Memorandum	25
	1	89/08/31	Agenda for public hearing on August 31, 1989	USEPA		Other	26
	7	84/06/19	USEPA Pleadings/Order informing that the agency has identified hazardous	Valdas V. Adamkus USEPA	A.Hausler/G.Guenther	Pleadings/Order	27

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			substances at the Ionia Landfill Site. The order requires the City of Ionia to partake in specific measures. Two forwarding letters are attached; one to the city of Ionia and the other to MDNR				
	18	83/10/14	Report with cover letter from Technical Assistance Team (TAT) containing recommendations	Robert J. Bowden; Jeff Stefferahn; John Thorsen; USEPA	F.Pollack - USEPA	Reports/Studies	28
	70	83/11/17	Remedial Action Master Plan for Ionia City Landfill	Hazardous Site Control Division USEPA		Reports/Studies	29
	88	84/05/24	Technical Reports for IT Corporation; reports include: results and quality assurance data, method performance data, methodology, QA protocol and report appendices	Denis C.K. Lin Environmental Testing & Certification Corporation	K.Sullivan-IT Corporation	Reports/Studies	30
	16	89/08/00	Proposed plan for Remedial Action	USEPA		Reports/Studies	31
	67	89/09/29	Record of Decision	USEPA		Reports/Studies	32

GUIDANCE DOCUMENT INDEX SUPPLEMENT TO THE ADMINISTRATIVE RECORD INDEX FOR IONIA CITY LANDFILL SITE, IONIA, MICHIGAN. THESE DOCUMENTS HAVE NOT BEEN COPIED. HOWEVER, THEY MAY BE REVIWED AT THE USEPA REG. V OFFICES, CHICAGO, IL.

TITLE	AUTHOR	DATE	OSWER/EPA REFERENCE #
Guidelines for Exposure Assessment (Federal Register, Sept. 24, 1986, p. 34042).	USEPA	86/09/24	
Guidelines for Carcinogen Risk Assessment (Federal Register, Spet. 24, 1986, p. 33992).	USEPA	86/09/24	
EPA'S Implementation of the Superfund Amendments and Reauthorization Act of 1986.	Thomas-USEPA	87/05/21	
Guidelines and Specification for Preparing Quality Assurance Program Documentation.	ORD/Quality Assurance Mgmt. Staff-USEPA	87/05/01	
Land Disposal Restrictions.	Longest & Lucero-USEPA	87/08/11	
Remedial Action Costing ocedures Manual.	JRB Assoc., CH2M Hill, USEPA	87/10/01	
Laboratory Data Validation Functionai Guidelines For Evaluating Organics Analyses.	Bleyer-Viar & Co.,USEPA Data Review Wkshp., HSED	88/02/01	
Information on Drinking Water Action Levels.	Fields-OSWER/ERD - USEPA	88/04/19	
Laboratiry Data Validation Functional Guidelines For Evaluating Inorganics Analysis.	Data Review Work Group,Bleyer-Viar & Co.,HSED	88/07/01	
Remedial Response Actions At Hazardous Waste Sites: Summary Report.	ORD/HERL	84/03/01	EPA 540/2-84/002A
Geophysical Technigues For Sensing Buries Wastes and Waste Migration.	Benson, et al-Technos,Inc. & Vanee-EMSL-USEPA	84/06/01	EPA-600/7-84/064
Field Screening Methods Catalog: User's GGuide.	OERR/HSED	88/09/01	EPA/540/2-88/005
Practical Guide For Ground Water Sampling.	Barcelona, et al-Ill. Water Survey, Scalf-ORD/ERL	85/09/01	EPA/600/2-85/104
.actical Guide-Trial Burns For Hazardous Waste Incinerators.	Corman,et al-Midwest Research Inst,Oberacker-USEPA	86/04/01	EPA/600/2-86/050

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TITLE	AUTHOR	DATE	OSWER/EPA REFERENCE #
Soil Sampling Quality Assurance User's Guide.	Barth & Mason-U. of Nevada Las Vegas	84/05/01	EPA/600/4-84/043
Sediment Sampling Qulaity Assurance User's Guide.	Barth&Starks-U.of Nevada-Las Vegas,Brown-ORD/HARD	85/07/01	EPA/600/4-85/048
Treatment Technology Briefs: Alternatives To Hazardous Waste Landfills.	HWERL	86/07/01	EPA/600/8-86/017
Community Relations in Superfund: A Handbook.	OERR - USEPA	88/06/01	OSWER 9230.0-03B
CERCLA Compliance With Other Environmental Statutes.	Porter-USEPA	85/10/02	OSWER 9234.0-02
CERCLA Compliance With Other Laws Manual.	OERR-USEPA	88/08/08	OSWER 9234.1-01
User's Guide to the Contract Laboratory Program.	OERR/CLP Sample Mgmt. Off. - USEPA	88/12/01	OSWER 9240.0-01
Policy On Flood Plains And Wetland Assessments For CERCLA Actions.	Hedeman & Lucero-USEPA	85/08/01	OSWER 9280.0-02
Field Standard Operating Procedures Manual #'s four and eight - Site Entry and Air Surveillance.	OERR/HRSD	85/01/01	OSWER 9285.2-01,03
Field Standard Operating Procedures Manual #'s six and nine - Work Zones and Site Safety Plan.	OERR/HRSD	85/04/01	OSWER 9285.2-04,05
Final Guidance for the Coordination of ATSDR Health Assessments Activities With the Superfund Remedial Process.	Porter-USEPA & ATSDR	87/05/14	OSWER 9285.4-02
Superfund Public Health Evaluation Manual.	OERR & OSWER - USEPA	86/10/01	OSWER 9285.4-1
Superfund Exposure Assessment Manual.	OERR- USEPA	88/04/01	OSWER 9285.5-1
A Compendium Of Superfund Field	OERR & OWPE	87/12/01	OSWER 9355.0-14

GUIDANCE DOCUMENT INDEX SUPPLEMENT TO THE ADMINISTRATIVE RECORD INDEX FOR IONIA CITY LANDFILL SITE, IONIA, MICHIGAN. THESE DOCUMENTS HAVE NOT BEEN COPIED, HOWEVER, THEY MAY BE REVIWED AT THE USEPA REG. V OFFICES, CHICAGO, IL.

TITLE	AUTHOR	DATE	OSWER/EPA REFERENCE #
Operations Methods.			
Interim Guidance On Superfund Selection of Remedy.	Porter-USEPA	86/12/24	OSWER 9355.0-19
Data Quality Objectives for Remedial Response Activities: Example Scenario: RI/FS Activities At A Site With Contaminated Soils And Ground Water.	CDM Fed. Pgms. Corp. & OERR/OWPE	87/03/01	OSWER 9355.0-7B
Data Quality Objectives for Remedial Response Activities: Development Process.	CDM Fed. Pgms. Corp. & OERR/OWPE	87/03/01	OSWER 9355.0-7B
Guidance For Conducting Remedial Investigations and Feasibility Studies Under CERCLA.	OSWER/OERR	88/10/01	OSWER 9355.3-01
ts of Remedial Response Actions at Uncontrolled Hazardous Waste Sites.	Rishel, et al-SCS Eng. & Albrecht-HERL	81/01/01	OSWER 9360.0-08
Alternate Concentration Limit Guidance Part 1, ACL Policy and Information Requirements.c	OSW/WMD - USEPA	87/07/01	OSWER 9481.00-6C
Interim Guidance on Potentially Responsible Party Participation in Remedial Investigations and Feasibility Studies.	Porter-USEPA	88/05/16	OSWER 9835.1a
Endangerment Assessment Guidance.	Porter-USEPA	85/11/22	OSWER 9850.0-1
Endangerment Assessment Guidance.	Porter-USEPA	85/11/22	OSWER 9850.0-1

ADMINISTRATIVE RECORD SAMPLING/DATA INDEX
IONIA CITY LANDFILL, IONIA, MICHIGAN.
DOCUMENTS NOT COPIED, MAY BE REVIEWED AT THE USEPA REGION V OFFICES, CHICAGO, ILLINOIS.

DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
00/00/00	Raw data and chain-of-custody forms are also available for review at: Rollins Environmental Services-FS 9009 Gulf Freeway, suite 245 Houston ,Texas 77017 and at Earth Technologies Corp. Baton Rouge, Louisiana and Houston , Texas.			Sampling/Data
00/00/00	Water Well Records.	Ionia Township		Sampling/Data
82/06/25	Laboratory Data Package for case #1051; sample #'s 82MS09S73 - 76 and 82MS09R18.	USEPA	USEPA Sample Mgmt. Off.	Sampling/Data
82/06/25	Sampling Results for sample numbers E1428, 1569, 1571, and 1573 extracted on 5/14/82.	West Coast Technical Service, Inc.		Sampling/Data
82/06/29	Data package and review for Case #1051; sample #'s E1428 to 1574.	Rene Van Someren-Ecol. & Environ.	Dan Sewall-Ecol. & Enviro	Sampling/Data
82/07/09	Sampling Results for sample #'s A1397 - 8.	California Analytical Labs	USEPA	Sampling/Data
82/07/13	Data package and review for case #1051; sample #'s E1568 to 1575.	Rene Van Someren-Ecol. & Environ.	Dan Sewall-Ecol.& Environ	Sampling/Data
82/07/26	Data package and review in case #1051; sample #'s ME9201 - ME9032.	Chuck Ely-USEPA	USEPA - FIT	Sampling/Data
86/10/30	Precision and Accuracy of Analysis for Data Set SF 3811. eleven water samples. This package includes the data sheets and the chain-of-custody forms.	Steve Parker-USEPA	Peter Miller-USEPA	Sampling/Data

ADMINISTRATIVE RECORD SAMPLING/DATA INDEX
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DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
86/11/13	Precision and Accuracy of Analysis for Data Set SF 3560 for nine water samples. This package includes the data sheets.	Steve Parker-USEPA	Peter Miller-USEPA	Sampling/Data
87/07/22	Analytical results from the Ionia City Landfill monitor well sampling activity.	Rick Smith-Rollins Environmental	Peter Miller-USEPA	Sampling/Data
87/08/24	Lab results for drum samples from Test Pit #8.	Gary Hoffmaster-MDNR	Peter Miller-USEPA	Sampling/Data
87/10/20	Partial analytical data package from the residential well sampling activity.	Rick Smith-Rollins Environmental	Peter Miller-USEPA	Sampling/Data
86/12/12	Ionia City Landfill Third Round Monitoring Well Analytical Data.	Rick Smith-Rollins Environmental	Mike Gifford-USEPA	Sampling/Data